

RAND

The Distribution of Teachers Among California's School Districts and Schools.

*Stephen Carroll, Robert Reichardt, and
Cassandra Guarino assisted by Andrea Mejia.*

MR-1298.0-JIF

October 2000

Prepared for The James Irvine Foundation

RAND Education

This is a final report of a project. It has been formally reviewed but has not been formally edited.

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

20001211 111

*RAND is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.
RAND's publications do not necessarily reflect the opinions or policies of its research sponsors.*

PREFACE

This study analyzes the flows of teachers, into, out of, and within California's school districts and schools. We explore the factors that affect the distributions of qualified teachers and, consequently, of underqualified teachers and vacancies among schools and school districts serving different student populations.

This research was funded by the James Irvine Foundation. It is part of a larger body of research on the quality of teaching and on school reform efforts being conducted by RAND Education.

CONTENTS

| | |
|---|-------|
| Preface | iii |
| Figures | vii |
| Tables | ix |
| Summary | xiii |
| Acknowledgments | xxiii |
| 1. INTRODUCTION | 1 |
| This Study | 1 |
| Teacher Qualification | 2 |
| Background | 4 |
| Data | 8 |
| Analysis Opportunities and Limitations | 12 |
| Overview | 15 |
| 2. PREVIOUS RESEARCH ON THE MARKET FOR TEACHERS | 16 |
| Teacher Demand | 16 |
| Teacher Supply | 17 |
| Factors in Attrition & Retention | 19 |
| 3. THE DEMAND FOR TEACHERS | 25 |
| 4. THE SUPPLY OF TEACHERS TO DISTRICTS | 31 |
| Overview | 31 |
| The Supply of Returning Teachers | 33 |
| The Supply of Teachers from Outside the District | 49 |
| The Supply of Credentialed Teachers from Outside the District | 50 |
| The Total Supply of Teachers from Outside the District | 65 |
| Conclusions | 68 |
| 5. THE SUPPLY OF TEACHERS TO SCHOOLS | 72 |
| Overview | 72 |
| The Supply of Teachers from inside the District | 74 |
| The Supply of Returning Teachers | 74 |
| The Supply of Transferring Teachers | 74 |
| The Supply of Credentialed Newly Hired Teachers | 101 |
| The Total Supply of Teachers to Schools | 115 |
| Conclusions | 118 |
| 6. SUMMARY AND CONCLUSIONS | 122 |
| Appendix: A Conceptual Framework for Examining the Labor Market for Teachers .. | 129 |
| Bibliography | 138 |

FIGURES

| | | |
|---|---|----|
| 1 | The Flows of Teachers Described by the Linked Data..... | 11 |
|---|---|----|

TABLES

| | | |
|------|--|----|
| 1.1 | District Characteristics in 1995 | 11 |
| 3.1a | Regression Results: Districts' Demands for Teachers, 1994 | 28 |
| 3.1b | Regression Results: Districts' Demands for Teachers, 1995 | 29 |
| 3.2 | Districts' Demands for Teachers | 30 |
| 4.1a | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Leave Their District: All Teachers | 37 |
| 4.1b | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Leave Their District: Grade K-3 Teachers | 38 |
| 4.1c | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Leave Their District: Grade 4-6 Teachers | 39 |
| 4.1d | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Leave Their District: Grade 6-8 Teachers | 40 |
| 4.1e | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Leave Their District: Grade 9-12 Teachers in Math & Science | 41 |
| 4.1f | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Leave Their District: Grade 9-12 Teachers in Other Subjects | 42 |
| 4.2a | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Leave Their District: All Teachers | 43 |
| 4.2b | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Leave Their District: Grade K-3 Teachers | 44 |
| 4.2c | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Leave Their District: Grade 4-6 Teachers | 45 |
| 4.2d | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Leave Their District: Grade 6-8 Teachers | 46 |
| 4.2e | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Leave Their District: Grade 9-12 Math and Science Teachers | 47 |
| 4.2f | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Leave Their District: Grade 9-12 Other Teachers | 48 |
| 4.3a | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: All Teachers | 52 |
| 4.3b | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: K-3 Teachers | 53 |
| 4.3c | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: Grades 4-6 Teachers | 54 |

| | | |
|------|---|----|
| 4.3d | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: Grades 6-8 Teachers | 55 |
| 4.3d | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: Grades 6-8 Teachers | 56 |
| 4.3e | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: Grades 9-12 Math Science Teachers | 57 |
| 4.3f | Logistic Regression Results: Odds That Teachers Newly Hired in 1995 Will Have a Credential: Grades 9-12 Other Teachers | 58 |
| 4.4a | Logistic Regression Results: Odds That Teachers Newly Hired in 1996 Will Have a Credential: All Teachers | 59 |
| 4.4b | Logistic Regression Results: Odds That Teachers Newly Hired in 1996 Will Have a Credential: K-3 Teachers | 60 |
| 4.4c | Logistic Regression Results: Odds That Teachers Newly Hired in 1996 Will Have a Credential: Grade 4-6 Teachers..... | 61 |
| 4.4d | Logistic Regression Results: Odds That Teachers Newly Hired in 1996 Will Have a Credential: Grade 6-8 Teachers..... | 62 |
| 4.4e | Logistic Regression Results: Odds That Teachers Newly Hired in 1996 Will Have a Credential: Grade 9-12 Math Science Teachers..... | 63 |
| 4.4f | Logistic Regression Results: Odds That Teachers Newly Hired in 1996 Will Have a Credential: Grade 9-12 Other Teachers | 64 |
| 4.5 | Regression Results: Fraction of New Hire Target Achieved, 1995 | 66 |
| 4.6 | Regression Results: Fraction of New Hire Target Achieved, 1996 | 67 |
| 4.7 | Odds That Teachers Will Leave Their District | 68 |
| 4.8 | Odds That Newly Hired Teachers in a District Will Have a Credential: | 70 |
| 4.9 | Regression Results: Fraction of New Hire Target Achieved, | 70 |
| 5.1a | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Transfer: All Teachers..... | 78 |
| 5.1b | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Transfer: K-2 Teachers..... | 80 |
| 5.1c | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Transfer: Grades 4-6 Teachers | 82 |
| 5.1d | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Transfer: Grades 6-8 Teachers | 84 |
| 5.1e | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Transfer: Grades 9-12 Math Science Teachers | 86 |
| 5.1f | Logistic Regression Results: Odds That Teachers Employed in 1994 Will Transfer: Grades 9-12 Other Teachers | 88 |

| | | |
|------|--|-----|
| 5.2a | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Transfer: All Teachers..... | 90 |
| 5.2b | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Transfer: Grade K-3 Teachers | |
| 5.2c | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Transfer: Grade 4-6 Teachers..... | 94 |
| 5.2d | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Transfer: Grades 6-8 Teachers | 96 |
| 5.2e | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Transfer: Grade 9-12 Math and Science Teachers | 98 |
| 5.2f | Logistic Regression Results: Odds That Teachers Employed in 1995 Will Transfer: Grades 9-12 Other Teachers | 100 |
| 5.3a | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1995 Will Be Credentialed: All Teachers | 103 |
| 5.3b | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1995 Will Be Credentialed: Grade K-3 Teachers | 104 |
| 5.3c | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1995 Will Be Credentialed: Grade 4-6 Teachers | 105 |
| 5.3d | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1995 Will Be Credentialed: Grade 6-8 Teachers | 106 |
| 5.3e | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1995 Will Be Credentialed: Grade 9-12 Math and Science Teachers | 107 |
| 5.3f | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1995 Will Be Credentialed: Grade 9-12 Other Teachers | 108 |
| 5.4a | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1996 Will Be Credentialed: All Teachers | 109 |
| 5.4b | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1996 Will Be Credentialed: Grade K-3 Teachers | 110 |
| 5.4c | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1996 Will Be Credentialed: Grade 4-6 Teachers | 111 |
| 5.4d | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1996 Will Be Credentialed: Grade 6-8 Teachers | 112 |
| 5.4e | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1996 Will Be Credentialed: Grade 9-12 Math and Science..... | 113 |
| 5.4f | Logistic Regression Results: Odds That A Newly Hired Teacher Assigned to a School in 1996 Will Be Credentialed: Grade 9-12 Other Teachers | 114 |
| 5.5 | Regression Results: The Relative Distribution of Teaching Positions Among Schools, 1994 | 116 |

| | | |
|------|---|-----|
| 5.6 | Regression Results: The Distribution of Teaching Positions Among Schools, 1995..... | 117 |
| 5.7 | Odds That Teachers Will Transfer | 118 |
| 5.8 | Odds That Newly Hired Teachers Assigned to a School Will Have a Credential: | 120 |
| 5.9 | The Relative Distribution of Teaching Positions Among Schools | 121 |
| 6.1a | Regression Results: Percent of Elementary Teachers Who Hold a Credential | 126 |
| 6.1b | Regression Results: Percent of Secondary Teachers Who Hold a Credential.. | 126 |

SUMMARY

STUDY OBJECTIVES

This study analyzes the teacher labor market in California. Specifically, we develop a series of models of the flows of both fully qualified and underqualified teachers, into and out of California's school districts and among the schools within those districts. For purposes of this analysis, we consider teachers who have fulfilled the requirements for a teaching credential to be fully qualified. We consider teachers who entered classrooms on the basis of an emergency permit or waiver less than fully qualified or underqualified. We use these models to explore the factors that affect the distributions of qualified teachers, underqualified teachers, and vacancies among schools and school districts serving different student populations.

We have no measures of teacher quality other than whether or not an individual employed in a teaching position had earned a teaching credential. We assume that a fully credentialed teacher is preferred to a teacher who lacks a full credential. Districts unable to recruit the numbers of qualified teachers they desired to hire had the option of simply leaving a position vacant. The substantial numbers of underqualified teachers employed by California districts indicates that an underqualified teacher is generally preferred to a vacancy. Hence, we have two measures of the quality of a district's teaching staff: the fraction of total position that are vacant and the fraction of the teaching staff that are underqualified. Our primary concern is to identify the factors that affect the distributions of these measures among districts serving diverse student populations.

Because the labor market has been shown to be different for elementary teachers compared to high school teachers, and for math or science teachers compared to those who teach other subjects, we divide teachers into five groups depending on whether their primary assignment was in grades K-3, 4-6, 6-8, 9-12 math/science, or 9-12 other subject. Grade 6 teachers who work in self-contained classrooms are counted with the elementary

grade teachers (4-6), and grade 6 teacher who work in departmentalized classroom are counted with the middle school teachers (6-8).

DATA

Information on teacher characteristics is collected annually by the State Department of Education via the Professional Assignment Information Form (PAIF). All professionals (teachers, principals, counselors, etc) that work in California school districts complete this questionnaire each October. The PAIF provide information about each teacher's age, race, education level, and the work they do.

To analyze teachers' transitions into, out of, and between schools from one year to the next, we linked responses on the PAIF in one year with the responses for the following year. The analysis was done on a sample comprising those districts that provided reliable information for linking teachers across years. The end result is the final sample of districts was made up of about 738 of the roughly 1058 districts in California. The majority of school districts that were dropped were relatively small. Some rather large districts, including Los Angeles Unified School District (LAUSD) had to be excluded because of data limitations. The data for the sample of districts included in this study include all teachers who were employed in a sample district in one or more of the 1994, 1995, and 1996 school years. Because each teacher in the sample was assigned a unique identification number, we can identify those teachers who were employed in the same district (school) in 1994 and 1995 and those teachers who were employed in the same district (school) in 1995 and 1996.

THE DEMAND FOR TEACHERS

We consider two alternative empirical models of the demand for teachers. In the first model, we assume the district determines its desired teacher/pupil ratio, given its revenues, teacher salary level, its students' characteristics, and other characteristics. The district would then presumably subtract the number of its returning teachers to determine the number of teachers it will have to hire to meet its desired teacher/pupil ratio. In the

second, we assume the district recognizes its returning teacher force, and its salary obligations to them. Accordingly, it subtracts the salary obligations to its returning teachers from its revenues to determine its discretionary revenues¹ and then decides on the number of new hires it desires given its discretionary budget.

The important result, from the perspective of this study, is that none of the measures of students' characteristics had a significant effect on districts' demands for teachers in either year. Whatever else may be true, we have no reason to believe that districts serving different pupil populations have systematically different preferences for the number of teachers they seek to employ per pupil. Hence, differences in the distributions of teachers serving different student populations are not a product of differences in districts' demands for teachers.

THE SUPPLY OF TEACHERS TO A DISTRICT

The primary source of teachers to a district is the pool of teachers employed in the district the previous year. Each year, districts fill the large majority of their teaching positions with returning staff. The other sources from which teachers are recruited are the pool of credentialed teachers not employed in the district the previous year and the pool of individuals who do not have a teaching credential but who would be willing to enter teaching if a position they considered attractive were offered to them.

The Supply of Returning Teachers

The relationship between the proportion of a school's students who are Black and the likelihood that a teacher in that school will not return to the district is clear. The odds that a teacher will leave the district are positively related to the percent Black in the teacher's school for all teachers combined and for the teachers in four of the five separate

¹ Districts have numerous financial obligations beyond what it will have to pay its returning teachers. But we lack detailed information of districts' obligations. We take the revenues that are available to a district after taking account of a district's obligations to its returning teachers as an indicator of funds it must consider in deciding on the number of teachers it will add to the teaching force.

grade level groups in both of the transition years included in our data. The magnitude of the effect varies somewhat between years and grade levels.

There are no consistent patterns in the relationships between the other descriptors of the student population in a school and the likelihood that a teacher from that school will leave the district. For all teachers combined, there is a positive relationship between the odds that a teacher will leave a district and the proportion of pupils in the teacher's school who are Hispanic. However, when we divide teachers into groups depending on the grade level at which the teacher is working, we generally do not obtain significant effects for either the transition from 1994 to 1995 or for the 1995/6 transition. Similarly, we find a significant negative relation between the odds that a teacher will leave the district and percent of the pupils in his or her school who are eligible for free lunch. But that relationship does not appear when we examine the various groups of teachers separately.

The Supply of Credentialed Teachers from Outside the District

We used data for 1995 and 1996 to model districts' ability to attract qualified teachers in 1995 and in 1996. The dependent variable is the fraction of newly hired teachers in a district who are credentialed.

The results are mixed. The percent of a district's students who are Black and the percent of a district's students who are Hispanic each have consistently negative effects on a district's ability to recruit credentialed teachers. However, the magnitude of this effect is not consistently significant.

The Total Supply of Teachers from Outside the District

We also modeled a district's ability to attract teachers, regardless of their qualifications. The dependent variable is the ratio of the number of newly hired teachers, both credentialed and not credentialed, to the sum of the number of newly hired teachers plus the number of vacant teaching positions in the district. In other words, it is the fraction of the hiring target that was met, regardless of the qualifications of the newly hired teachers.

The variables measuring district and student characteristics are generally insignificant. The important result, from the perspective of this study, is that the only student characteristic that had a significant effect on the distribution of vacancies among districts in both years is the percent of the pupils that are Hispanic. Districts serving disproportionate numbers of Hispanic students found it more difficult to fill teaching positions than did other districts. Otherwise, there is no evidence that districts serving different pupil populations have systematically different success in recruiting the teachers they need to achieve their hiring targets.

THE FLOWS OF TEACHERS WITHIN DISTRICTS

The primary source of teachers to a school is the pool of teachers employed in the school the previous year. The second source of teachers to a school is the pool of teachers employed in other schools in the district. Returning teachers can transfer to vacant positions in other schools within the district. The third source of teachers to a school is the pool of newly hired teachers. The district recruits teachers from outside the district, decides which applicants will be employed, and assigns newly hired teachers to the positions left vacant after returning teachers have distributed themselves throughout the district.

The Supply of Returning Teachers

A teacher who decides to return to a district may return to the same school that he or she had been in the previous year. Or, he or she might seek a transfer to another school. As noted earlier, the odds that a teacher will leave the district are significantly positively related to the percent Black in the teacher's school. Other things equal, schools serving disproportionate numbers of Black students will have relatively fewer returning teachers and, thus, will have to recruit relatively many teachers from other schools in the district or from outside the district.

The Supply of Transferring Teachers

Enrollment growth and teacher exits from schools create vacancies throughout a district. The teachers employed in the district the prior year have the right to transfer from their school to another school in the district in which there is a vacancy. We used our data to model the factors that affected the relative attractiveness of a school to the teachers who remained in a district from one year to the next.

The results are dramatic. The odds that a teacher will transfer out of a school are significantly positively related to both the percent Black and the percent Hispanic in the school for all teachers combined and for the teachers in each of the five separate grade level groups in both of the transition years included in our data. The odds that a teacher will transfer into a school are significantly negatively related to both the percent Black and the percent Hispanic in the school. Here, too, the result holds for all teachers combined and for the teachers in each of the five separate grade level groups in both transition years included in our data. The magnitudes of these effects vary between years and grade levels. But there is a consistent pattern: Teachers tend to transfer out of schools having relatively high minority pupil populations and into schools having relatively low populations of minority pupils.

The Supply Of Credentialed Newly Hired Teachers

The third source of teachers to a school is the pool of newly hired teachers. We explored the extent to which the characteristics of a school's pupil population affect the likelihood that the newly hired teachers the district assigns to that school are fully credentialed. Specifically, for the subset of teachers who were newly hired by a district in our sample in 1995 or in 1996, we defined an indicator variable which had the value zero if a teacher was not credentialed and one if the teacher had a teaching credential. We regress this indicator on measures of the factors that might be related to a district's assignment policies.

The probability that a newly hired teacher assigned to a school will be fully credentialed is closely related to the characteristics of the pupils in the school. For all teachers combined, and for most of the grade level subgroups, in both years, the odds that a newly hired teacher assigned to a school will be credentialed vary inversely with the proportions of Black or Hispanic students at that school. The result partially reflects the pattern we observed above: Districts with relatively many minority students have more difficulty in recruiting credentialed teachers than do districts serving relatively fewer minority students. However, the results for the effects of the school's student body suggests that within districts, the newly hired teachers assigned to those schools serving relatively few minority students are more likely to be credentialed than are the newly hired teachers assigned to schools serving relatively many minority students.

The Total Supply Of Teachers To Schools

To explore the extent to which the number of teachers a district allots to any particular school is based its' students characteristics, we compute the difference between the district-wide teacher/pupil ratio and the teacher/pupil ratio at each school in the district. If the difference is negative, the school has a larger teachers/pupil ratio than the district average; that is, it has fewer teachers per pupil than do the other schools in the district, on average. We then regress this difference on school and district characteristics.

The regression coefficients for the percent of the pupils in a school that are Black or Hispanic are positive and highly significant in both years. Schools serving disproportionate numbers of Black or Hispanic students are allocated fewer teachers per pupil than do other schools in the same district in which the fractions of the student body are drawn from these populations are smaller.

CONCLUSIONS

California has established criteria for the skills and knowledge teachers are presumed to need to be effective. A teaching credential does not guarantee that the person holding the credential will be an effective teacher. And there are likely some individuals who lack a credential but are, nonetheless, very effective teachers. However, absent evidence to the

contrary, we assume that the quality of the education offered to the students in a school depends on the extent to which their classes are taught by teachers qualified to teach.

Assuming that possession of a credential in subject matter taught in a class is a necessary condition for an effective education, the quality of the education offered various pupil populations will depend on the fraction of the teachers in their school who are credentialed. From this perspective, the analyses described above suggest that the quality of the education offered Black and Hispanic students is relatively deficient in comparison to the quality of the education offered other students. Specifically, the processes that affect the distribution of teachers among and within school districts systematically result in higher fractions of underqualified teachers in the districts and schools serving disproportionate numbers of Black and Hispanic students.

The analyses presented above describe an interacting series of processes which, together, determine the distribution of teachers among districts and schools. Teachers leave their schools and districts for a variety of reasons, many of which have nothing to do with the characteristics of students or their schools or districts. However, teachers are relatively more likely to leave districts and schools serving disproportionate numbers of Black and Hispanic students. This pattern may reflect teachers' direct responses to students' characteristics. Or the effects of these characteristics may be indirect in the sense that these districts and schools are relatively less attractive to teachers who are, therefore, relatively more inclined to respond to an external force or inducement drawing them away from these districts and schools. Either way, the result is that districts and schools and districts serving disproportionate numbers of Black and Hispanic students incur relatively higher numbers of vacancies and, therefore, have relatively more positions to fill.

This pattern is replicated at the school level within districts. The odds that a teacher will leave a school are significantly positively related to the percent Black in the school. Some of the teachers who leave a school within a district transfer to other schools in the same district. Teachers tend to transfer out of schools having relatively high minority pupil populations and into schools having relatively low populations of minority pupils. A disproportionate fraction of intradistrict transfers involve teachers moving from schools serving relative large numbers of Black and Hispanic students to schools serving

relatively smaller numbers of these students. Thus, the vacancies within a district tend to gravitate toward those schools serving disproportionate numbers of Black and Hispanic students. In sum, schools serving relatively many minority students incur relatively many vacancies to start with. Then, the vacancies in those schools serving relatively few minority populations tend to “shift” from those schools to the schools whose pupil populations include higher fractions of Blacks and Hispanics.

Whatever may be the distribution of vacancies within a district, districts serving relatively high minority populations have relatively less success in attracting credentialed teachers. The racial/ethnic distribution of the students in a district was significantly related to the district’s ability to recruit credentialed teachers. Further, the racial/ethnic composition of a school’s student body is correlated with the odds that newly hired, credentialed teachers will be assigned to it. Within districts, the newly hired teachers assigned to those schools serving relatively few minority students are more likely to be credentialed than are the newly hired teachers assigned to schools serving relatively many minority students. The odds that a newly hired teacher assigned to a school will be credentialed vary inversely with the proportions of Black or Hispanic students at that school.

Finally, some of the positions left unfilled after credentialed teachers are allocated to schools are filled by underqualified teachers. When all is said and done, the total number of teachers, credentialed or underqualified, per pupil at schools serving relative large numbers of Black or Hispanic students tend to have fewer teachers per pupil than do schools serving few of these students.

The dynamics of the labor market for teachers result in relatively greater initial vacancy rates in districts and schools serving disproportionate numbers of Black and Hispanic students. Intradistrict transfers then tend to “shift” vacancies within districts from those schools serving relatively large numbers of other students to those schools serving relatively large numbers of Black and Hispanic students. Although these processes result in increased relative vacancy rates in districts and schools serving Black and Hispanic students, these districts and schools are relatively less successful in recruiting credentialed teachers. In combination, these processes result in relatively less well

qualified teacher staffs in the districts and schools serving disproportionate numbers of Black and Hispanic students.

ACKNOWLEDGMENTS

Many people have contributed to this effort. We particularly thank RAND colleagues Dominic Brewer, Sheila Nataraj Kirby, and Ron Zimmer for their helpful comments and suggestions on an earlier version of this report. We also thank RAND colleague Brian Stecher and other members of the CSR research consortium who helped us gain access to some of the databases used in this study. While we recognize the contributions of the many people who made this report possible, we emphasize that the discussion and findings in this report reflect only the views of the authors.

1. INTRODUCTION

THIS STUDY

California's public education system is widely thought to be ineffective. When 40 states and other jurisdictions are ranked according to the reading performance of eighth graders on the 1998 National Assessment of Educational Progress (NAEP), California ranked 35th.² The reading performance of California's fourth graders was even worse when compared to the rest of the nation. California ranked 40th of 43 states and other jurisdictions on that measure.³ While the characteristics of California's students differ from those in other states in several important respects, these differences cannot account for California's students' poor performance on these tests. For example, when the states are ranked according to the reading performance of students eligible for free or reduced cost school lunch, California ranks at the very bottom of the list both for fourth graders and for eighth graders.⁴

Whatever else might be true, the teacher is the critical element in K-12 education. Hence, the quality of the teachers in California's schools is a critical factor in improving the quality of education in California. However, California has recently experienced severe shortages of qualified teachers. In 1998, the most recent year for which data are available, California school districts reported 2,284 vacant teaching positions, approximately nine percent of the total positions schools had sought to fill. (We refer to a school year by the date in which the school year begins. Thus, we refer to the 1995-96 school year as 1995.) Further, nearly 13 percent of the roughly 284,000 teachers

² Donahue, et al. (1999), Fig. 5.10, p. 128.

³ Donahue, et al. (1999), Fig. 5.9, p. 127.

⁴ Donahue, et al. (1999), Table 5.9, p. 139 and Table 5.10, p. 140..

employed in California's school districts that year were not fully qualified. Of particular concern, inequities in access to qualified teachers appear to be correlated with students' characteristics such that, "... those students in greatest need of effective teachers are most likely to be in classrooms with underqualified teachers."⁵

Previous studies of the market for teachers in California have examined the teacher shortage at the state level and recommended policies aimed at increasing the flow of qualified teachers into classrooms.⁶ But there appears to be little chance that the shortages will soon be eliminated. The question, then, is what can be done to reduce the extent to which the effects of the shortage are concentrated on students in greatest need?

The first step in developing answers to that question is to develop an understanding of the processes that affect the distributions of teachers among schools and districts. The movements of teachers into, within, out of, and, sometimes, back into districts and schools serving diverse populations all bear on the qualifications of the teacher force serving those populations whose needs are greatest. These processes reflect decisions made by districts, current teachers, credentialed teachers not currently employed in teaching, and college graduates who lack a teaching credential but are willing to enter a classroom on an emergency permit or waiver.

This study analyzes the flows of both qualified and underqualified teachers, into, within, out of, and back into California's school districts and schools. Our objective is to identify the factors that affect the distributions of qualified teachers, underqualified teachers, and vacancies among schools and school districts serving different student populations.

TEACHER QUALIFICATIONS

The search for the skills, knowledge, and attributes that make a teacher effective has spawned a substantial research literature. There is, however, little agreement within this

⁵ Shields, et al. (1999), p. iv. Similar results are reported in Betts, et al. (2000).

literature. While many studies have found that teachers' training and certification affect student achievement, many other studies have failed to find a relationship between student achievement and various indicators of teacher qualifications. The interpretation of the results of many of the past studies is further clouded by methodological shortcomings: Studies suffer from limited scope, sampling bias, and lack of statistical controls for prior student achievement or other background characteristics. Studies have generally been conducted at the school, district, or state level ignoring the variation of teacher characteristics within a school and not addressing the potential interactions between teacher- and student-level traits. Finally, many studies focus on formal teacher qualifications rather than what occurs in the classroom. In sum, the empirical evidence does not provide consistent strong support for specific measures that translate into enhanced teaching.

However, California, like every other state, establishes requirements teachers must meet to legally enter a public school classroom. The California Commission on Teacher Credentialing (CTC), a State Agency, sets the requirements for credentials that authorize public school teaching. School districts are generally enjoined from employing a teacher who lacks a teaching credential. Absent strong evidence to the contrary, we assume that the requirements established by the CTC represent the best available understanding of the skills and knowledge an individual must possess to teach effectively. Presuming that the CTC requirements reflect the best knowledge as to the qualifications for an effective teacher, individuals employed as teachers who lack a teaching credential are underqualified.

In response to the current teacher shortage, the CTC has established alternatives to the teaching credential—Internship Credentials, Emergency Permits, and short-term and variable term waivers.⁷ School districts are permitted to employ individuals who have not satisfied the requirements for a teaching credential as a teacher under one or another of these alternatives. Moreover, since the onset of the teacher shortage, California

⁶ Shields, et al. (1999) and Betts, et al. (2000).

districts have hired large numbers of teachers under one or another of the CTC's alternatives to a teaching credential. Districts unable to recruit the numbers of fully qualified teachers they desired to hire had the option of simply leaving a position vacant. The substantial numbers of underqualified teachers employed by California districts indicates that an underqualified teacher is generally preferred to a vacancy.

Hence, we have two measures of the quality of a district's teaching staff: the fraction of total positions that are vacant and the fraction of the teaching staff that are underqualified. Our primary concern is to identify the factors that affect the distributions of these measures among districts serving diverse student populations.⁸

To be sure, a teaching credential does not guarantee that the person holding the credential will be an effective teacher. And it seems likely that some, perhaps many, of those who have entered classrooms without a credential are, nonetheless, very effective teachers. However, absent strong evidence to the contrary, we assume that the quality of the education offered to the students in a school depends on the extent to which their classes are taught by teachers qualified to teach those classes in the sense that they have met the standards California has set for teaching credentials. Accordingly, this analysis focuses on the flows of qualified and underqualified teachers that affect that affect the distributions of teachers among districts and schools serving various types of students.

BACKGROUND

The current teacher shortage in California results from a confluence of three forces--class size reduction, demographics, and a rapidly expanding state economy. These three forces combined to rapidly increase the numbers of teachers California schools districts sought to employ. Because the numbers of people qualified to teach and interested in entering a

⁷ See, for example, California Commission on Teacher Credentialing (1999).

classroom did not grow as rapidly, shortages and the employment of underqualified teachers ensued. All three of these forces are likely to continue to influence the market for teachers for years to come; hence, the problem of attracting sufficient numbers of fully qualified teachers into California classrooms are likely to continue.

In 1996, California embarked on an ambitious effort to reduce class sizes in kindergarten through third grade. Class sizes at the time averaged about 29 students per classroom in grades K – 3. In its first year, 1996, the Class Size Reduction (CSR) program provided an additional \$650 per pupil to schools districts for every K – 3 grade student in a classroom in which there were 20 or fewer students. The reimbursement rate was raised to \$800 per pupil the next year. Although the program is voluntary, the vast majority of California's schools have reduced class sizes in the targeted grades.⁹ Almost 90 percent of first-grade students and significant fractions of second- and third-grade students were enrolled in reduced size classes in 1996. The following year, almost all first- and second-grade students and almost two-thirds of kindergarten and third-grade students program were enrolled in smaller classes.

The schools had to hire large numbers of additional teachers to provide smaller classes.¹⁰ In 1996, 73,693 teachers were assigned to K – 3 classrooms, roughly 10,000 more than the number of teachers who would have been assigned to those classrooms had the 1995 teacher pupil ratio continued. In 1997, the number of teachers assigned to K – 3 classrooms exceeded the number that would have been needed in those classrooms to meet the 1995 teacher pupil ratio by more than 25,000. An analysis of the projected teaching staff that would be needed to meet CSR goals each year through 2004 estimated that approximately 21,000 additional teachers would be needed in each year.¹¹

⁸ In any event, the data available for this study do not include any measures of teacher quality other than whether or not an individual employed in a teaching position had earned a teaching credential.

⁹ Bohrnstedt and Stecher (1999), p. xii.

¹⁰ Bohrnstedt and Stecher (1999).

¹¹ Fetter (1997).

Ongoing demographic trends have led to substantial growth in K – 12 enrollments in California. The number of students enrolled in California's elementary and secondary schools grew by almost one million over the 1990s, from less than five million students in 1990 to just under six million students 1999.¹² Averaged over all grade levels, California schools employ about one teacher for every 23 students. The growth in enrollments over the 1990s meant that the teacher force at the end of the decade would have had to be roughly 35,000 greater than it was at the beginning of the decade just to maintain average class sizes, totally aside from CSR.

Meanwhile, in the mid-1990s, the state's economy emerged from a deep recession and entered an era of extremely rapid growth. In turn, the soaring economy resulted in huge increases in state tax revenues. Proposition 98 establishes a minimum share of the state's General Fund that must be allocated to K – 14 education, of which about 90 percent is allocated to K – 12. Further, K – 12 education has fared well in budget debates; state General fund allocations to K – 12 education have frequently exceeded the Proposition 98 floor. In all, while total state spending grew at an annual average rate of almost six percent over the 1990s, K – 12 education saw slightly larger annual increases.¹³

In sum, CSR and enrollment growth combined to drastically increase the numbers of teachers California school districts needed to meet teacher pupil ratio targets during the second half of the 1990s. During this time period, state support for K – 12 education also grew rapidly, providing the funds needed to drastically increase the numbers of teachers school districts could afford to hire. However, there has not been any corresponding surge in the numbers of qualified teachers seeking employment in the school. The result has been shortages of qualified teachers. School districts have either made do with fewer teachers, and consequently larger class sizes, than desired or hired underqualified teachers.

¹² CBEDS

¹³ Legislative Analyst's Office (2000).

CSR has proved very popular. Notwithstanding the problems school districts have encountered in implementing CSR, no one has suggested that the program be reversed. If anything, there is growing pressure to extend CSR to additional grades. Similarly, demographic projections imply continued growth in K – 12 enrollments. Total K – 12 enrollments across the state are expected to grow by more than half a million students between 1999 and 2004.¹⁴ All indications suggest that the numbers of teachers school districts would need to meet teacher pupil ratio targets will continue to grow.

Future trends in the state's economy are obviously uncertain. The present expansion has been underway for about seven years and history suggests that expansions inevitably end sooner or later. But there is no sign of a significant decline in the near term, so it seems likely that school districts' budgets will continue to grow, providing the means to increase the numbers of teachers school districts attempt to hire. It thus seems likely that teacher shortages will continue in California. Hence, the question of how those qualified teachers who are available to the schools are distributed among them and, consequently, how various types of student populations are affected by the shortages, is likely to be a continuing concern.

A persistent shortage may result in a gradual redistribution of teacher skills across different types of schools and districts. The principal hypothesis guiding this report is that a shortage will set in motion a process in which teachers possessing more desirable qualifications will sort into schools and districts that are considered to be more desirable. Under persistent shortage conditions, this process will lead over time to inequities in the quality of education delivered to different groups of students. Although certain features of teacher hiring and compensation policy mitigate this type of sorting, other features encourage it. This report traces patterns in teacher shortages, the movements of teachers across schools and districts, and shifts in the skill distributions of California teachers with the aim of shedding light on the mechanisms which determine changes in the distribution of qualified teachers over time.

¹⁴ Fetter (1997).

Specifically, we address four research questions at the district level. Are there systematic differences among districts serving different pupil populations in:

- the number of teachers per pupil they seek to employ?
- the fraction of teachers employed in the district in one year who return the following year?
- the district's ability to recruit fully qualified teachers? And,
- the district's ability to attract teachers regardless of qualifications?

We also address four research questions at the school level. Specifically, are there systematic differences among schools serving different pupil populations in:

- the fraction of teachers employed in a school in one year who return the following year?
- a school's ability to attract teachers from other schools within its district?
- the extent to which the district assigns fully qualified newly hired teachers to a school? And,
- the number of teachers per pupil the district assigns to a school regardless of qualifications?

DATA

Most of the data used in this study were derived from California's Comprehensive Basic Educational Data System (CBEDS). CBEDS contains data the State Department of Education collects each October from counties and school districts (district level statistics, including teacher shortages and demands), schools (numbers of students and non-certificated staff), and professional (certificated) staff. The main source of information on teacher characteristics is the Professional Assignment Information Form (PAIF). All certificated staff (teachers, principals, counselors, etc) that work in school districts complete this questionnaire each October. Through the PAIF teachers provide

information about themselves (age, race/ethnicity, education, credentials, years of service) and their work assignments.

The PAIF allows respondents to describe up to eight different work assignments. Respondents are classified as teachers if they spend the majority of their time working in teaching assignments. Grades are assigned based on the grade level of students in classrooms where they spend the plurality of their time.

For the analysis of transitions, responses on the PAIF in one year had to be linked with the responses for the following year. Teacher identification numbers (usually a social security number) provided on the PAIF were used to follow individuals across years. Only PAIF files from the years 1992 through 1996 are available with identification numbers.¹⁵ A key issue for this analysis was creating a sample of districts that provided reliable identification codes on the PAIF. Some districts (and individuals) use their own coding system instead of the social security number, and others do not provide identification codes. Unfortunately, the Los Angeles Unified School District (LAUSD) was one of the districts that did not provide identification codes.

The analysis was done on a sample of districts that were selected because they provided reliable information for linking teachers across years. Districts were dropped from the sample based on four indicators of unreliable identification numbers. When a certain proportion of PAIF respondents met any one of these indicators, for any of the years 1992-1996, then that district was dropped from the sample for all years being examined. The indicators and thresholds for removing a district out are:

- lack of identification number, (5%)
- duplicate identification numbers within a given year (10%)
- very low rate of linking between years, i.e. less than 70% of respondents in any one year can be linked with respondents in the next year

¹⁵ The identification codes on the released PAIF files were scrambled to protect individuals' identities.

- a high rate of false links (5%), those links where the identification codes are the same, but the individuals sex, race or age does not remain the same indicating a false link

The end result is the final sample of linked districts was made up of about 738 of the roughly 1058 districts in the state. The majority of school districts that were dropped were relatively small. The decision rules for excluding unreliable districts are biased against small districts because only one or two respondents with a mistake in completing the PAIF could cause the district to be excluded. However, some rather large districts had to be excluded.

The districts in the sample resemble districts in the state when LAUSD is excluded. Table 1.1 below shows the characteristics of all school districts in the state, all school districts in the state not including LAUSD, the sample, and LAUSD alone in 1995. Schools in the sample have a slightly higher percentage of white students and a slightly lower percentage of students eligible for free and reduced lunch than the state without LAUSD. The characteristics of LAUSD are different from the average state district. It is much larger and has many more Hispanic students as well as students eligible for free and reduced lunch.

Table 1.1
District Characteristics in 1995

| | Statewide | Statewide without LAUSD | Sample | LAUSD |
|--|-----------|----------------------------|--------|-------|
| Total Students (000s) | 5,468 | 4,821 | 3,824 | 648 |
| Percent White | 40 | 44 | 45 | 12 |
| Percent Black | 9 | 8 | 8 | 14% |
| Percent Hispanic | 39 | 35 | 35 | 66 |
| Percent Asian | 11 | 12 | 11 | 7 |
| Percent American Indian | 1 | 1 | 1 | 0 |
| Percent Free and Reduced Lunch Eligible | 46 | 43 | 41 | 70 |

Data on the beginning, average, and maximum teacher salary for each district is taken from California J-90 "Salary and Benefits Schedule for the Certificated Bargaining Unit." This voluntary survey was issued in May 1996 and was completed by over 80% of school districts. Data on the district expenditures is taken from the J-200 "Annual Survey of District Revenues and Expenditures."¹⁶

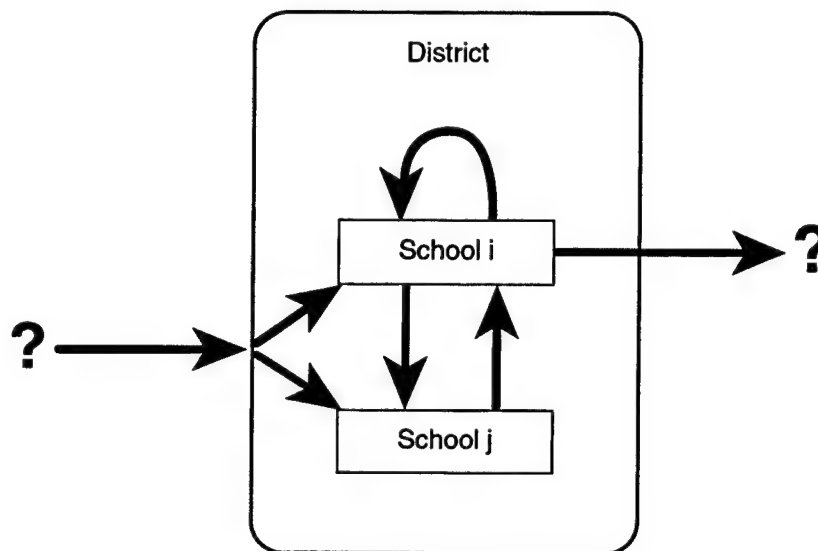
All descriptive data on schools and districts come from the Common Core of Education Data (CCD), gathered and maintained by the U.S. Department of Education. The CCD is the Department of Education's primary database on public elementary and secondary education in the United States. CCD is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts."¹⁷

¹⁶ Both of these data sets are public and can be downloaded from <ftp://ftp.cde.ca.gov/>.

¹⁷ The U.S. Department of Education web page is located at <http://nces.ed.gov/ccd/aboutccd.html>. The CCD can be downloaded from <http://nces.ed.gov/ccd/ccddata.html>.

ANALYSIS OPPORTUNITIES AND LIMITATIONS

Figure 1 summarizes the extent to which the linked data describe the flows of teachers into, within, and out of districts and schools. It also suggests the major limitations of the data available for this analysis.



RAND A2562 9/00

Figure 1
The Flows of Teachers Described by the Linked Data

The linked database includes all teachers who were employed in a sample district in the 1994, 1995, and 1996 school years. Because each teacher in the sample was assigned a unique identification number by their district, we can identify those teachers in a district in 1995 or 1996 who had been employed in that district the previous year. By implication, we can identify those teachers who were hired into each sample district in 1995 and 1996 and those teachers who left each sample district in each of those years. However, the data do not consistently describe either what teachers newly hired by a sample district were doing the previous year or what teachers who left a sample district did the following year. If a teacher employed by a sample district that used Social Security numbers as the identification code in one year happens to move to a district that

is also in the sample and that also used the Social Security number as the identification code in the following year, we will observe a teacher moving from the former district in the first year to the latter in the second. But the data do not track teachers who move into or out of districts that used a coding system other than Social Security number regardless of where they were employed the previous or subsequent year.

Thus, the data identify teachers new to a district. But we cannot distinguish among newly hired teachers who have just completed teacher training, or who completed their training some years earlier and have been engaged in some activity other than teaching since then, or who were teaching in a district that didn't use Social Security numbers as identification codes, or in a private school, or out of state. Similarly, the data do not distinguish among teachers who leave a district to engage in some nonteaching activity, including retirement, illness, or another occupation, or to teach in another district that does not use Social Security numbers as identification codes or in a private school, or out of state.

The data allow us to identify teacher transfers among schools within a sample district. Thus, we can identify the teachers in each school who remained in that school from one year to the next or transferred to that school from another school in the same district. We can also identify the teachers newly hired by the district who were assigned to that school, though we do not know what those teachers were doing the previous year.

In general, we use the teacher as the unit of analysis in exploring the factors related to flows into, within, and out of a school district. This way we can control for the possibility that some types of teachers, distinguished by their characteristics, experience, etc., may be more likely to engage in certain types of movements than are other types of teachers. For example, as we will see below, relatively inexperienced teachers are more likely to terminate than are more experienced teachers. Consequently, rapidly growing districts that need to hire relatively more new teachers, on average, than their slower growing counterparts, end up in an unfortunate spiral: Because they need to bring in relatively many new teachers, their teacher force includes a relatively high proportion of

inexperienced teachers who, in turn, are relatively more likely to terminate. So, the following year, their hiring needs are even greater, they hire an even greater fraction of inexperienced teachers, have higher turnover rates, and so on. If it happens that districts serving disproportionate numbers of type X students are growing more rapidly than are other districts, it may appear that the presence of relative large numbers of type X students engenders relatively high rates of teacher turnover whereas, in fact, it is the propensity of inexperienced teachers to terminate at relatively greater rates.

However, we model school or district level decisions at the school or district level. For example, districts determine the numbers of teachers they will seek to employ. Accordingly, we examine districts' demands for teachers at the district level. Similarly, districts recruit teachers and decide which applicants they will hire. Thus, we examine the relative ability of districts to attract and employ qualified teachers at the district level.

Because the labor market has been shown to be different for elementary teachers compared to high school teachers, and for math or science teachers compared to those who teach other subjects, we divided teachers into five groups. There are two groups of elementary teachers, graded K-3 and 4-6. K-3 is separated from grades 4-6 to allow for examination of possible effects of class size reduction that was implemented in the school year beginning in 1996. The sample of elementary teachers is made up exclusively of teachers who work in self-contained classrooms. The K-3 group includes teachers who have mixed graded classrooms that include students from grades 3 and 4. The 4-6 group includes teachers who teach mixed grade classes with students from grades 4-8.

The other grade groupings, 6-8, 9-12 math/science and 9-12 other subject, are made up of departmentalized teachers. Thus grade 6 teachers who works in self-contained classrooms are counted with the elementary grade teachers (4-6), and grade 6 teacher who work in departmentalized classroom are counted with the middle school teachers (6-8).

However, some of our data do not distinguish among teachers by grade level. For example, our data indicate the total number of teachers employed by each sample district and the number of vacancies reported by each sample district. But districts do not report vacancies by grade level. In analyzing districts' demands for teachers, we take the sum of the number of teachers employed plus the number of vacancies as each district's total demand for teachers. But, because vacancies are not reported by grade level, we have no basis for examining districts' demands for teachers at any grade level. Rather, we have to conduct that part of the analysis at the aggregate level; that is, the total number of teachers the district sought to hire.

The analyses reported here include all schools, students, and teachers in every district in the sample. For example, we include charter schools and special education students and teachers.

OVERVIEW

Section 2 reviews previous studies of the labor market for teachers. Section 3 presents our analysis of the demand for teachers at the school district level. Section 4 presents our analyses of the flows of teachers into and out of school districts. Section 5 presents our analyses of the flows of teachers among schools within districts. Finally, our conclusions are presented in Section 6. The Appendix applies a standard competitive labor market framework to the particular characteristics of the teacher labor market to identify the data needed to more fully examine the market for teachers.

2. PREVIOUS RESEARCH ON THE MARKET FOR TEACHERS

The purpose of a teacher supply-demand model is to estimate future levels of demand and supply as demographics, economic conditions, and educational policies vary. This is a considerable challenge, not only conceptually but methodologically as well. While there are some examples of such complete models, much of the literature focuses on a single aspect of the system at a time. In general, the literature can be grouped into research on demand, supply, and attrition and retention.

TEACHER DEMAND

There are two basic ways to define teacher demand. One is simply the number of teachers employed, which we will refer to as **constrained** demand. Schools face many constraints, however, and may not always be able to employ the number, type, or quality of teacher that they would prefer. Thus the concept of **unrestricted** demand represents the number of teachers who would be hired without such constraints.

For either concept, there are three major components driving teacher demand. These are changing enrollment, school policies that affect the student/teacher ratio, and teacher turnover. The simplest demand models hold the latter two constant and use demographic data to project future teacher demand. The latest models used by the National Center for Educational Statistics include factors of disposable income per capita and local education revenue in addition to elementary and secondary enrollment. Barro (1995) suggests that a complete demand model must include per capita income, the pupil-population ratio and the price of teachers (relative salary), ideally using panel data.

These models have their limitations, however. Predicting enrollment is more difficult at the state or district level than at a national one because of migration and fertility differences. Enrollment predictions also tend to be more accurate for elementary schools, because current models are not able to account for such factors as high school dropouts.

There is also concern that national level projections do not provide adequate information for decision makers at the district or school level. For example, even when models showed an excess supply of teachers, there was concern that they masked teacher shortages in particular subjects and/or geographic locations. The research that tries to address these concerns examines other variables that may affect demand, generally at the school or district level. Richards (1986), for example, explored the role of race at the school level. Multinomial logit analysis allowed him to look at the probability of a particular teacher being hired in a school, where schools were categorized into four levels of minority enrollment. His explanatory variables included personal characteristics (race, sex, education, experience, credentials) and job related characteristics (elementary or secondary teacher and recent changes in ethnic proportions). By holding supply constant, he tried to capture the effect of changing enrollment. His results show that newly hired minority teachers are more likely to find jobs in rapidly growing schools with a large minority population.

TEACHER SUPPLY

The supply side is much more difficult to model, partly due to the many paths individuals may take to a teaching career. There are two main sources of teachers – continuing teachers and new teachers. New teachers, in turn, may either be traditional new graduates or they may come from a reserve pool of qualified individuals. This reserve pool includes migrating teachers, former teachers, education graduates who never taught, and those who could transfer from other occupations. This process is further complicated by the many factors that influence whether or not an individual chooses to enter the teaching profession.

The research into this area has been focused around three main questions. First, what factors are associated with someone choosing to be a teacher? Second, what are the factors that either reduce attrition or increase retention? Third, what influences the quality of the available supply?

In order to identify the paths to teaching, several researchers have used occupational choice models. Zarkin (1985) develops a model in which he assumes teachers to be rational agents who base their decision on expected starting salaries. He found that the projected number of future children influences the number of secondary school graduates. Manski (1987) also uses occupation choice to evaluate variables such as class rank, SAT/ACT score, salary, non-monetary job characteristics, and worker-specific characteristics. He found that increases in teaching earning yield substantial growth in the size of the teaching force, while establishing minimum qualifications reduced the teaching force. This research had relied on aspirations data, survey responses of individuals who planned on pursuing a career in teaching. Hanushek & Pace (1993) advance these models by working with data that reflected current teachers' views. Using the High School & Beyond survey, they found that raising teacher requirements (such as the number of professional credits or a minimum NTE score) or increasing course requirements lowers the probability that an individual will finish an education degree. They also found evidence supporting the observation that individuals scoring high on the NTE test were less likely to enter the teaching profession.

In their research on teacher attrition, Murnane et al (1988) found that returning teachers provide a significant source of newly hired teachers in a given year. Additional results (Murnane et al, 1989) from North Carolina supported these findings. Grissmer & Kirby (1992) conducted a similar study using Indiana data over the period 1965-1987. Their analysis further suggested that the changing labor force had a significant impact on the teacher supply, because over that time alternative occupations for women greatly expanded.

A survey study (Kirby, Grissmer & Hudson, 1991) focused specifically on the different paths new teacher take. They found that individuals re-enter teaching mainly for additional family income, because of a decrease in childcare responsibilities, and because of dissatisfaction with current occupations. Those returning from other occupations tended to come from administrative, sales, or other educational (i.e. substitutes)

occupations. They also found that migrating teachers, those moving from another district, often did so because of a spousal job transfer. Finally, they noticed that certification year is a better predictor of whether someone will enter teaching than graduation year.

Recent work in this area has looked at how to increase the number of minority teachers and how to attract teachers to urban districts. There is evidence that urban schools not only suffer shortages of certified teachers, but that they have much higher attrition rates. Villegas & Clewell (1998) found that paraprofessionals and emergency-certified teachers provide a large pool of potential teachers, especially Hispanics and Blacks.

FACTORS IN ATTRITION & RETENTION

Due to the recent demographic changes and the projected shortage of teachers, there is an even greater concern over what factors lead to teacher attrition and what factors may encourage teacher retention.

Chapman & Green (1986) test a model developed by Green that sees teacher attrition as a result of social learning. They explored five areas - personal characteristics, educational preparation, initial commitment to teaching, quality of first teaching experience, integration into teaching, and external influences - and found significant differences among those who had never taught, those who had left, and those who had continually taught since college graduation. The most significant variables were initial commitment to teaching and salaries. Surprisingly, those who left teaching had the lowest current salaries, which is counter to the idea that teachers leave for higher wages.

Theobald (1990) modeled teachers as economically rational decision-makers who choose among alternatives so as to maximize their utility. In addition to life cycle factors, personal characteristics, and professional characteristics, he included district characteristics such as enrollment, property wealth, expenditures, class size, student demographics, and the local unemployment rate. While he found that a higher salary was associated with higher retention, he noticed this only for male teachers. Among female

teachers, years of experience and an elementary assignment were associated with higher retention. Finally, he found evidence that there is a strong correlation between educational attainment and attrition, with those who have a master's degree or doctorate much more likely to leave than those without. These results, he suggests, supports the hypothesis that male teachers pursue graduate degrees in order to qualify for higher-paying administrative positions.

Brewer's (1996) work seeks to test this hypothesis. The New York state data he used allowed for the identification of career separations, that is, whether a teacher remains as a teacher, becomes an administrator, moves to another district, or leaves the state. Using hazard modeling, he found that men are sensitive to administrative rewards (primarily being a larger salary), but that women are not. He argues that this is probably because there are fewer opportunities for women in administration.

The theory of human capital proposes that workers decide to enter, stay, or leave an occupation by comparing assessments of the monetary and non-monetary benefits of different occupations. Part of this assessment includes weighing the amount of human capital that an individual has built up within a profession. This suggests that there will be less movement in mid-career because the human capital specific to an occupation acts as a barrier to mobility. Based on this theory's assumptions, Rickman and Parker (1990) examined the effect of wage differences between teacher salaries and the occupations teachers are most likely to enter if they leave teaching. They confirmed that teachers are sensitive to wage differentials, with the result that higher teacher salaries decrease the probability of quitting. They also found that changing occupations increases with years of experience, although at a diminishing rate. Finally, given that most teachers are married, they included a proxy for family decision-making influences. In finding this variable to be significant, they argue this shows that the family benefits from an occupation change outweigh the financial risks.

Kirby & Grissmer (1993) also ground their work in this theory. Their survival analysis of Indiana data confirmed the existence of a U-shaped attrition curve. They found that

younger, new teachers have the highest rates of attrition, middle-aged teachers have the lowest, and that attrition rates increase as teachers near retirement. Beaudin (1995) uses this approach to look specifically at the reserve pool of teachers and district characteristics. She found that three variables were significant in her analysis – higher beginning salaries, the level of per pupil expenditures in the district, and student-teacher ratios.

The bivariate approach, as defined above, is more common in the literature. Early research suggested that variables such as sex, age, and years of experience influenced attrition rates (Charters, 1970). Baugh & Stone (1982) were one of the first to empirically show that teachers were responsive to wage differentials. Murnane & Olsen (1989) extended this analysis using hazard models, which predict the probability that a teacher will stop teaching in a specific year given that he or she has taught up to that year. This methodology now predominates in the literature on attrition and retention. Their model included many personal and school characteristics. Concerning the issue of salary, they found that a \$1,000 increase in salary translated into an increase of more than 4 years in the median length of a career.

Using the same approach, Mont & Rees (1996) then added course-specific, such as class size, number of classes taught, proportion of classes taught in teachers' subject area, and average quality of students. They found that higher student quality, years of experience, and higher salaries are all associated with lower attrition rates while teaching outside of a subject area was associated with higher attrition. Overall they found that teachers with less than four years of experience seemed to be more sensitive to workplace conditions. Numerous other studies have also found a significant relationship between salary and attrition (Murnane et al, 1991; Theobald, 1990, Kirby et al, 1999). A few have even identified an impact from differences in beginning salaries, with higher beginning salaries raising retention (Grissmer & Kirby, 1991; Beaudin, 1995).

In contrast to the salary concerns, Gritz & Theobald (1995) explore the influence of other district expenditures on teacher attrition. They use a hazard model to explore six types of

expenditures: teacher salary, administration, support activities, classified staff, teaching materials, and other education. They find that increased spending on administration and classified staff increases attrition rates. Thus, simply increasing salaries may be negated if spending in these areas increases as well.

Personal characteristics such as age, gender, race, educational background, education level, experience, credentials, and performance assessment have been tested in various models. Across the literature, several have been clearly identified as having an effect on attrition rates. As mentioned earlier, the relationship between age and retention is U-shaped (Grissmer & Kirby, 1987; Murnane et al, 1988; Murnane et al, 1989; Singer, 1993; Theobald, 1990). There appears to be a gender effect, with women having higher retention rates than men (Grissmer & Kirby, 1991; Singer, 1993; Theobald, 1990). Several studies have found that black teachers have higher retention rates than whites (Beaudin, 1995; Kirby et al, 1996; Singer, 1993), but other studies have found no significant difference among races (Theobald, 1990).

The other main group of variables examined includes district and school characteristics. It has been conclusively shown that attrition rates vary depending on whether the teacher is in an elementary or secondary school and by subject specialty (Grissmer & Kirby, 1993; Kirby et al, 1997; Murnane & Schwinden, 1989). High school teachers have higher attrition rates, and chemistry and physics teachers have the highest attrition rates among subjects. Comparatively lower pupil-teacher ratios have been associated with lower attrition (Grissmer & Kirby, 1991; Kirby et al, 1999), although Theobald found the opposite. A few have examined fiscal attributes, such as district wealth (Theobald, 1990), per pupil expenditures (Beaudin, 1995; Kirby et al, 1999), and median household income (Mont & Rees, 1996). While the latter studies found retention associated with greater amounts of fiscal resources, Theobald found that teachers in wealthy districts are more likely to leave teaching. He suggested that teacher salaries are relatively low compared to other salaries in wealthy districts, and thus those teachers face higher opportunity costs. Kirby et al (1999) also found that increasing administrative staff led to higher attrition rates. Finally, a few studies have tried to capture quality aspects, such as

the score on the National Teacher Examination (Murnane & Schwinden, 1989; Murnane & Olsen, 1990) or the student dropout rate (Mont & Rees, 1996). The former found that teachers who scored higher on the NTE were more likely to quit, while the latter found that higher student quality led to greater retention.

A few studies have looked at subgroups of teachers or schools. Singer (1993) specifically looks at the pool of special educators who return to teaching. Applying hazards modeling to Michigan data, her results show that the longer a teacher is removed from teaching, the less likely she is to return, while the longer she taught the more likely she was to return. Specifically, for each extra year of experience the odds of return were 9% higher. She also found that special educators had higher return rates than regular teachers.

Kirby et al (1999) used hazard models to examine the effect of teacher race and the 'riskiness' of a district on attrition. They incorporated variables such as targeted race and risk (defined as the percent of children eligible for free school lunch) in their analysis of Texas schools. Their model controlled for beginning teacher salaries, differences in student-teacher ratios, instructional expenditures per pupil, and percent of administrative and support staff. Their list of personal and district characteristics controlled for such things as primary teaching assignment, urban city, and age at entry, in addition to the more standard variables. Their work confirmed many earlier findings, but also concluded that working in a high-risk district increased attrition rates. Furthermore, they were able to conclude that minority teachers are more affected by working conditions, in part because a greater percent of them work in high-risk districts.

Finding flaws with both the multivariate and bivariate approaches, Shen (1997) attempts to combine the two. He argues that the theory-driven approach tends to look at a narrow range of variables while the bivariate does not take into account the relationship among the variables related to retention/attrition. His approach is to compare three groups of teachers – those who stayed in the same school, those who transferred to another school, and those who left teaching – across a range of individual, school, and interaction variables. Using discriminant function analysis on a nationally representative data set, his

findings support many earlier conclusions, such as more experience and higher salary being associated with higher retention. However, he finds no relationship between attrition and race, gender, having a master's degree, full-time versus part-time status, undergraduate major, bilingual status, or the number of breaks from teaching. He found that teachers who transferred or left the profession were associated with schools that had more students on free lunch, a higher percentage of minority students, and a greater percentage of teachers with less than three years of experience.

3. THE DEMAND FOR TEACHERS

We assume a school district serving an exogenously determined number of students seeks to obtain the “best” combination of resources, or inputs, subject to an exogenously determined budget, exogenously determined salary levels, and district decision makers’ preferences. We do not suggest that a district has no influence on its enrollments, revenues, or the set of input prices it faces. Rather, we assume that the district’s decisions with respect to the number of teachers it will seek to employ depend only on the magnitudes of its enrollments, revenues, and teachers’ salary schedule—all of which are determined outside the model.

Specifically, a district’s enrollments are largely determined by demographic forces and parents’ choices between public and private schooling. Given enrollments, each district’s operating revenues per pupil are essentially determined by a formula. Districts negotiate the salary schedule with the teachers’ union. But once they reach an agreement, it generally remains in force for several years. Hence, in any given year, except in those districts in which the agreement with the teachers’ union has just ended, the factors that affect a district’s decision regarding the number of teachers it will seek to employ are largely predetermined.

We leave open the question of whether hypothesized preferences among inputs derive from district decision makers’ subjective perceptions of how various inputs affect educational outcomes, from traditional notions of what sets of inputs make up a “good” education, or from political/bureaucratic motives. The important question is whether there are systematic differences in the demands for teachers among districts serving diverse student bodies than affect the distributions of either vacancies or the fraction of teachers that are fully credentialed among districts. For example, it is conceivable that districts serving disproportionate numbers of type X students believe that smaller class

sizes are particularly important for that population and try to attain relatively high teacher/pupil ratios even though that means they will have make do with smaller amounts of other resources. If so, these districts will have relatively greater demands for teachers, which, in an era of shortage, might result in larger vacancy rates.

We consider two alternative empirical models of the demand for teachers. In the first model, we assume the district determines its desired teacher/pupil ratio, given its revenues, teacher salary level, its students' characteristics, and other characteristics. The district would then presumably subtract the number of its returning teachers to determine the number of teachers it will have to hire to meet its desired teacher/pupil ratio. In the second, we assume the district recognizes its returning teacher force, and its salary obligations to them. Accordingly, it subtracts the salary obligations to its returning teachers from its revenues to determine its discretionary revenues¹⁸ and then decides on the number of new hires it desires given its discretionary budget.

We used data for the 1994 and 1995 school years to estimate the models. Both years reflect the behavior of districts prior to the stresses and complexities of responding to the class size reduction program.

The student characteristics we consider are the racial/ethnic distribution of its students and the fraction of its students eligible for free lunch. It is possible that the number of special education students in a district affect its demand for teachers. However, those data were not available. The district characteristics we consider include its location (urban, suburban, or rural), size (number of schools and number of students), and the rate of growth in enrollments from the previous year. We also include the characteristics of the county in which the district is located (population density, the unemployment rate, average wage in all industries, average wage in federal employment).

¹⁸ Districts have numerous financial obligations beyond what it will have to pay its returning teachers. But we lack detailed information of districts' obligations. We take the revenues that are available to a district after taking account of a district's obligations to its returning teachers as an indicator of funds it must consider in deciding on the number of teachers it will add to the teaching force.

Preliminary analyses suggested that the effects of the size variables were nonlinear. To control for nonlinearities, we included those variables linearly, and cubed.

We devote our attention to the district's current operating revenues. Capital outlays and capital constraints are neglected throughout this analysis.

Table 3.1 presents the empirical results for regressions for each year. The first two columns of Table 3.1 shows the results for the model in which we assume a district considers the total number of teachers it will seek to employ, given its total budget. The dependent variable is the total number of teachers employed in the district, including both returning teachers and new hires, plus the number of vacancies reported by the district. The third and fourth columns of Table 3.1 shows the results for the model in which we assume a district considers the number of teachers it will seek to hire, given its discretionary budget. The dependent variable is the number of teachers the district hired plus the number of vacancies reported by the district. Both models include the average teachers' salary in the district, and the characteristics of the district, its students, and the county in which it is located. To facilitate the presentation, the dependent variables are expressed in terms of the number of teachers per one thousand pupils.

The model which assumes districts focus on total staff size has far more explanatory power than the model which assumes that districts focus on the number of teachers they will seek to add to their returning teacher force. In general, it appears that the total demand version of the model offers a much more accurate depiction of districts' behavior with respect to the demand for teachers.

Many of the variables included in the model were entered into the regression to control for the possible effects of factors outside the scope of education policymakers. They can do nothing about the characteristics of the county in which they are located, the numbers of students that have to be served, and so on. The primary policy variables available to policymakers are the size of the districts' budgets and teachers' salary levels. The primary interest of this study is to identify the flows that affect the distributions of

qualified teachers, underqualified teachers, and vacancies among schools and school districts serving different student populations. Accordingly, we are primarily concerned with the results for the policy variables and measures of student characteristics.

Table 3.1a
Regression Results: Districts' Demands for Teachers, 1994

| Dependent Variable | Mean | Standard Deviation | Desired teachers/ pupil | | Desired new teachers/ pupil | |
|---------------------------------------|----------|-----------------------|-------------------------|-------------|--------------------------------|-------------|
| | | | Coef | t-statistic | Coef | t-statistic |
| Total Demand for Teachers/pupil | 0.046 | 0.11 | | | | |
| Demand for New Teachers/pupil | 0.0014 | 0.0030 | | | | |
| Constant | | | 46.91 | (9.99) | -1.5 | (-0.92) |
| Total budget/pupil (\$000s) | 4.53 | 1.78 | 3.88 | (22.60) | | |
| Discretionary budget/pupil (\$000s) | 2.95 | 1.56 | | | 0.10 | (1.44) |
| Ave. teachers' salary (\$000s) | 25.16 | 2.28 | -0.49 | (-3.54) | 0.03 | (0.66) |
| Suburban | 0.65 | 0.48 | 0.55 | (0.59) | 0.42 | (1.27) |
| Rural | 0.23 | 0.42 | 2.76 | (2.31) | 0.22 | (0.52) |
| Fraction students Black | 0.04 | 0.07 | 3.33 | (0.66) | 3.11 | (1.77) |
| Fraction students Hispanic | 0.29 | 0.25 | 0.15 | (0.08) | 1.93 | (3.13) |
| Fraction students Asian | 0.06 | 0.09 | -2.78 | (-0.63) | -1.80 | (-1.17) |
| Fraction students Amer. Indian | 0.02 | 0.05 | -10.05 | (-1.40) | 1.30 | (0.52) |
| Fraction students free lunch eligible | 0.40 | 0.25 | -3.10 | (-4.05) | -0.06 | (-0.09) |
| Growth | 0.01 | 0.03 | -37.26 | (-4.05) | 4.00 | (1.24) |
| No. pupils (000s) | 5.99 | 23.43 | -0.54 | (-3.39) | 0.10 | (1.88) |
| No. pupils (000s) cubed | 3.02E+11 | 8.67E+12 | 0.00 | (1.65) | -0.00 | (-1.31) |
| No. schools | 8.55 | 24.86 | 0.00 | (1.55) | 0.04 | (0.89) |
| No. schools squared | 690.23 | 14171.08 | 0.00 | (1.75) | -0.00 | (-2.69) |
| No. schools cubed | 3.24E+05 | 9.09E+06 | -0.00 | (-1.82) | 0.00 | (2.17) |
| Ave. wage, all industries (\$000s) | 25.28 | 5.12 | -0.01 | (-0.52) | 0.01 | (1.26) |
| Ave. wage, federal employees (\$000s) | 35.95 | 5.20 | 0.00 | (0.09) | -0.04 | (-1.19) |
| Unemployment rate | 10.51 | 4.17 | -0.25 | (-2.32) | 0.00 | (0.16) |
| Population density | 1,591.68 | 996.88 | -0.49 | (-0.97) | -0.02 | (-1.02) |
| No. of observations | | | 856 | | 856 | |
| R Square | | | 0.48 | | 0.10 | |
| F | | | 37.86 | | 4.52 | |
| Significance of the regression | | | 0.0000 | | 0.0000 | |

Note: t-statistics in parentheses

Table 3.1b
Regression Results: Districts' Demands for Teachers, 1995

| Dependent Variable | Mean | Standard Deviation | Desired teachers/ pupil | | Desired new teachers/ pupil | |
|---------------------------------------|----------|-----------------------|-------------------------|-------------|--------------------------------|-------------|
| | | | Coef | t-statistic | Coef | t-statistic |
| Total Demand for Teachers/pupil | 0.0464 | 0.1042 | | | | |
| Demand for New Teachers/pupil | 0.0014 | 0.0031 | | | | |
| Constant | | | 28.72 | (8.46) | -2.82 | (-1.77) |
| Total budget/pupil (\$000s) | 4.66 | 1.24 | 6.21 | (31.82) | | |
| Discretionary budget/pupil (\$000s) | 3.03 | 1.00 | | | 0.49 | (4.40) |
| Ave. teachers' salary (\$000s) | 25.80 | 2.30 | -0.47 | (-4.47) | 0.00 | (0.01) |
| Suburban | 0.67 | 0.47 | -0.86 | (-1.25) | 0.16 | (.48) |
| Rural | 0.20 | 0.40 | 0.90 | (1.00) | 0.27 | (0.64) |
| Fraction students Black | 0.04 | 0.07 | -2.28 | (-0.62) | 1.82 | (1.05) |
| Fraction students Hispanic | 0.29 | 0.25 | -0.19 | (-0.14) | 1.86 | (2.93) |
| Fraction students Asian | 0.06 | 0.09 | -0.84 | (-0.26) | -2.17 | (-1.43) |
| Fraction students Amer. Indian | 0.02 | 0.06 | 7.91 | (1.70) | -3.94 | (-1.83) |
| Fraction students free lunch eligible | 0.41 | 0.25 | 0.54 | (0.42) | 0.10 | (0.17) |
| Growth | 0.01 | 0.03 | -17.02 | (-2.52) | 5.00 | (1.59) |
| No. pupils (000s) | 6.06 | 23.97 | -0.28 | (-2.48) | 0.01 | (1.53) |
| No. pupils (000s) cubed | 3.24E+11 | 9.28E+12 | 0.00 | (0.69) | -0.00 | (-1.16) |
| No. schools | 8.53 | 24.87 | 0.18 | (1.79) | 0.08 | (1.63) |
| No. schools squared | 690.49 | 14,130.43 | 0.00 | (0.06) | -0.00 | (-3.41) |
| No. schools cubed | 3.23E+05 | 9.05E+06 | -0.00 | (-0.30) | 0.00 | (2.56) |
| Ave. wage, all industries (\$000s) | 25.88 | 5.61 | 0.01 | (1.00) | 0.01 | (1.67) |
| Ave. wage, federal employees (\$000s) | 36.57 | 5.94 | 0.00 | (0.07) | -0.00 | (-0.50) |
| Unemployment rate | 10.09 | 4.67 | -0.11 | (-1.55) | -0.00 | (-0.03) |
| Population density | 602.63 | 1,007.02 | -0.51 | (-1.52) | -0.02 | (-0.10) |
| No. of observations | | | | 856 | | 856 |
| R Square | | | | 0.65 | | 0.12 |
| F | | | | 78.92 | | 5.56 |
| Significance of the regression | | | | 0.0000 | | 0.0000 |

Note: t-statistics in parentheses

Table 3.2 summarizes the results reported Table 3.1 for the policy and student variables. The entries indicate the sign of the effect. A single entry in any cell indicates that the estimated coefficient is not statistically significant (two-tailed test) at the 95 percent level. A double entry (++) or -- indicates a statistically significant estimate.

Table 3.2
Districts' Demands for Teachers

| | 1994 | 1995 |
|---------------------------------------|------|------|
| Total budget/pupil (\$000s) | ++ | ++ |
| Ave. teachers' salary (\$000s) | -- | -- |
| Fraction students Black | + | - |
| Fraction students Hispanic | + | - |
| Fraction students Asian | - | - |
| Fraction students Amer. Indian | - | + |
| Fraction students free lunch eligible | -- | + |

Both the budget and salary variables have the expected sign and are highly significant in both of the years. The variables measuring student characteristics are generally insignificant. None of the measures of students' characteristics had a significant effect on districts' demands for teachers in either year. Whatever else may be true, we have no reason to believe that districts serving different pupil populations have systematically different preferences for the number of teachers they seek to employ per pupil. Hence, differences in the distributions of teachers serving different student populations are not a product of differences in districts' demands for teachers.

4. THE SUPPLY OF TEACHERS TO DISTRICTS

OVERVIEW

We have no measures of teacher quality other than whether or not an individual employed in a teaching position had earned a teaching credential. We assume that a fully credentialed teacher is preferred to an underqualified teacher. California districts have hired large numbers of underqualified teachers. Districts unable to recruit the numbers of qualified teachers they desired to hire had the option of simply leaving a position vacant. The substantial numbers of underqualified teachers employed by California districts indicates that an underqualified teacher is generally preferred to a vacancy. Hence, we have two measures of the quality of a district's teaching staff: the fraction of total position that are vacant and the fraction of the teaching staff that are underqualified. Our primary concern is to identify the factors that affect the distributions of these measures among districts serving diverse student populations.

The supply of teachers to a district includes individuals drawn from several different pools. The primary source of teachers to a district is the pool of teachers employed in the district the previous year. Each year, districts fill the large majority of their teaching positions with returning staff. The other sources from which teachers are recruited are the pool of credentialed teachers not employed in the district the previous year and the pool of individuals who do not have a teaching credential but who would be willing to enter teaching if a position they considered attractive were offered to them. The pool of credentialed teachers includes credentialed teachers employed in other districts the prior year, individuals who have just obtained their credential, and people who hold a teaching credential but were not employed in teaching the prior year. While these groups differ in important ways, those differences are not relevant to this analysis. From our

perspective, they all hold a teaching credential and are, therefore, preferred to either underqualified teachers or vacancies. Similarly, the pool of underqualified teachers includes several different groups. But, the differences among them are not germane here. Each of these three manpower pools generates a supply of potential teachers. The supply of teachers from each of the manpower pools reflects individuals' occupational choices. Individuals employed in teaching in any year have the choice of returning to the district in which they were employed the following year, or leaving to engage in some other activity—teaching in another district, some nonteaching employment, retirement, and so on. Similarly, individuals qualified to teach but not employed in the district and individuals who are not qualified to teach, but would accept a teaching position if the terms of employment were attractive, have the choice of seeking a teaching position in the district. In each case, these choices are affected by the monetary (principally salary or wages) and nonmonetary (e.g., working conditions, concurrent hours) rewards associated with various occupations and by each particular individual's preferences for wage advantages relative to nonmonetary rewards. Whether or not an individual in each of these pools pursues a teaching position depends on the relative wages they would earn if they enter/return to teaching compared to what they would earn if they entered some other occupation and the nonmonetary rewards of teaching in the district relative to the nonmonetary rewards offered by the alternative occupations available to them.

The relative magnitudes of these effects will differ among the sources of supply and among the individuals in each relevant manpower pool. The important question is whether there are systematic differences in the supplies teachers to districts serving diverse student bodies than affect the distributions of either vacancies or the fraction of teachers that are fully credentialed among districts. For example, it is conceivable that teachers working in districts serving disproportionate numbers of type X students will find their work relatively more rewarding than will teachers working in districts serving different student populations and, consequently, more frequently return to the district in

the subsequent year. If so, these districts will have relatively greater supplies of returning teachers which, in an era of shortage, might result in smaller vacancy rates.

The difference between the number of teachers desired and the number of returning teachers is the number of new hires needed if the district is to achieve its desired staff level. The difference between the number of new hires needed and the number of new hires is the number of vacancies. The number of credentialed returning teachers plus the number of new hires from the pool of qualified teachers equals the number of credentialed staff. The number of noncredentialed returning teachers plus the number of new hires from the BA pool equals the number of noncredentialed staff.

Our data describe the numbers and qualifications of the teachers employed in each district in our sample. They also indicate the number of vacant positions reported by each district. In the empirical work reported below, we examine the processes that affect the number of vacancies experienced by a district and the fraction of a district's teaching staff that is fully credentialed. In each case, our primary concern is the extent to which, controlling for the district's enrollments, budget, and salary level, the characteristics of a district's students affect the flows of teachers into and out of a district in a way that influences the quality of its teaching force.

THE SUPPLY OF RETURNING TEACHERS

Our data for the sample of districts included in this study include all teachers who were employed in a sample district in the 1994, 1995, and 1996 school years. Because each teacher in the sample was assigned a unique identification number, we can identify those teachers who were employed in the same district in 1994 and 1995 and those teachers who were employed in the same districts in 1995 and 1996. Because the data include all teachers in the sample districts, we can identify the teachers employed in each district in each year who did not return the subsequent year. We used these data to explore the factors that affected teachers' decisions to either leave or return to the district in which

they taught the prior year. In particular, we explored the extent to which the characteristics of a district's students and of the students in the school in which the teacher was employed affected teachers' decisions to leave a district.

We defined an indicator variable which had the value zero if a teacher returned to the district in which he or she taught the prior year and one if the teacher left the district. We regress this indicator on measures of the factors that might influence a teacher's decision to return to, or leave, a district. We perform separate regressions for the transition from 1994 to 1995 and for the transition from 1995 to 1996. A teacher's working conditions and, hence, his or her decision to return to a district might vary by the grade level of his or her assignment. Accordingly, we performed separate analyses for each year for all teachers in the sample combined and for five separate groups of teachers divided by the grade level of their teaching assignment.

We regress the indicator on the percent of the district's students that are nonwhite and on the characteristics of the student body in the school in which the teacher taught in the first year of each transition. A teacher's decision to leave the district might be influenced by factors other than the characteristics of the students in the district or in the teacher's school. We also include the characteristics of the county in which the district is located (population density, the unemployment rate, average wage in all industries, average wage in federal employment). We also include the district's size in terms of both the number of pupils and the number of schools in the district, the rate of growth in enrollments from the prior year, and expenditures per pupil for instruction and for administration. We include the size and location (urban, suburban, or rural) of the teacher's school. Because teachers' characteristics might influence their return decision, we include a teacher's gender, experience, age, education level, race/ethnicity, and whether the teacher had a credential. We also include the size of the teacher's class in the first year of each transition.

A teacher's salary prospects also influences his or her decision to leave the district. We have data on each district's salary schedule. We enter the maximum salary in a teacher's district as a rough measure of the teacher's salary prospects.

We make no attempt to offer specific hypotheses regarding the effects of the variables listed above or to devise tests for alternative hypotheses regarding their effects. Our objective is to test for the effects, if any, of students' characteristics on teachers' decisions. We include these other variables in the regression to control for the possibility that some other factor might influence those decisions. We are not concerned for the particular reason why any other factor might affect those frequencies. Accordingly, we do not attempt to specify the precise nature, or even the direction, of a relationship, between any of these factors and a teacher's decisions to leave a district.

Preliminary analyses suggested that the effects of some of the independent variables was nonlinear. To control for nonlinearities, we included those independent variables both linearly and squared or cubed.

The results of logistic regressions of the indicator on the independent variables for the transition from 1994 to 1995 are presented in Table 4.1. Table 4.2 presents the corresponding results for the transition from 1995 to 1996. The standard errors and z-scores reported in Tables 4.1 and 4.2 have been adjusted to reflect the clustering of observations by school.

The relationship between the proportion of a school's students who are Black and the likelihood that a teacher in that school will not return to the district is clear. The odds that a teacher will leave the district are significantly positively related to the percent Black in the teacher's school for all teachers combined and for the teachers in four of the five separate grade level groups in both of the transition years included in our data. The magnitude of the effect varies somewhat between years and grade levels.

There are no consistent patterns in the relationships between the other descriptors of the student population in a school and the likelihood that a teacher from that school will leave the district. For all teachers combined, there is a significant positive relationship in both years between the odds that a teacher will leave a district and the proportion of pupils in the teacher's school who are Hispanic. However, when we divide teachers into groups depending on the grade level at which the teacher is working, we generally do not obtain significant effects for either the transition from 1994 to 1995 or for the 1995/6 transition. Similarly, we find a significant negative relation between the odds that a teacher will leave the district and percent of the pupils in his or her school who are eligible for free lunch. But that relationship does not appear when we examine the various groups of teachers.

Higher maximum teachers' salaries increase the likelihood that a teacher will return to a district for all teachers combined and for some groups of teachers. But the relationship between maximum teachers' salaries and the decision to leave a district is not consistently significant across the groups examined here.

The likelihood of leaving a district declines with a teacher's experience. The effect of experience is particularly pronounced for new teachers with no prior experience. New teachers with no prior experience are disproportionately likely to leave their district after their first year of teaching. A teacher's education level is also related to the odds that they will return. Less highly educated teachers, those with only a Bachelor's degree or less and those with some postgraduate credits up to a Master's degree are relatively more likely to leave a district compared to teachers with more than a Master's degree.

Interestingly, the size of a teacher's class did not have a strong effect on the decision to leave a district.

Table 4.1a

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Leave Their District:
All Teachers**

| | Mean | St.Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|------------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.08 | 0.28 | -15.14 | | 1.08 | -14.07 |
| Population density | 1,320.06 | 2,267.77 | 1.29E-05 | 1.00 | 0.00 | 1.00 |
| Unemployment rate | 9.14 | 3.43 | 7.82E-03 | 1.01 | 0.01 | 1.21 |
| Ave. wage, all industries | 27,806.30 | 4,901.31 | 1.52E-05 | 1.00 | 0.00 | 2.33 |
| Ave. wage, federal employees | 37,746.27 | 4,622.51 | 5.98E-06 | 1.00 | 0.00 | 1.31 |
| Per capita income | 22,224.67 | 4,721.49 | 1.03E-05 | 1.00 | 0.00 | 1.92 |
| No. Pupils in district | 17,203.81 | 16,065.24 | -2.10E-05 | 1.00 | 0.00 | -4.06 |
| No. pupils in district cubed | 2.54E+13 | 7.51E+13 | 2.66E-15 | 1.00 | 0.00 | 5.74 |
| No. schools in district | 22.56 | 21.66 | 7.63E-03 | 1.01 | 0.00 | 1.94 |
| No. schools in district cubed | 64,062.55 | 202,263.30 | -5.93E-07 | 1.00 | 0.00 | -2.17 |
| Maximum teachers' salary | 51,024.66 | 4,120.73 | -1.29E-05 | 1.00 | 0.00 | -2.78 |
| Rate of enrollment growth | 0.95 | 2.18 | 1.88E-02 | 0.98 | 0.01 | -2.98 |
| Inst. exp. /pupil | 1,813.96 | 172.68 | 1.54E-05 | 1.00 | 0.00 | -0.18 |
| Adm. exp./pupil | 179.01 | 25.11 | 4.89E-06 | 1.00 | 0.00 | 1.57 |
| Fraction nonwhite pupils in district | 0.52 | 0.25 | -2.31E-01 | 0.79 | 0.10 | -1.76 |
| No. pupils in school | 1,032.97 | 694.79 | 1.76E-04 | 1.00 | 0.00 | 4.43 |
| No. pupils in school cubed | 3.16E+09 | 8.13E+09 | -6.95E-12 | 1.00 | 0.00 | -2.81 |
| Pct. students Black | 6.76 | 9.71 | 1.69E-02 | 1.02 | 0.00 | 9.16 |
| Pct. students Hispanic | 32.73 | 25.54 | 5.96E-03 | 1.01 | 0.00 | 3.86 |
| Pct. students Asian | 10.42 | 12.81 | -1.65E-04 | 1.00 | 0.00 | -0.10 |
| Pct. students Am Indian | 0.62 | 2.44 | 2.40E-03 | 1.00 | 0.01 | 0.47 |
| Pct. students Free lunch eligible | 39.69 | 27.02 | -2.41E-03 | 1.00 | 0.00 | -2.62 |
| Class size | 30.66 | 12.79 | -2.21E-03 | 1.00 | 0.00 | -2.14 |
| Rural | 0.08 | 0.27 | 2.09E-01 | 1.23 | 0.07 | 3.74 |
| Urban | 0.30 | 0.46 | 1.16E-03 | 1.00 | 0.03 | 0.04 |
| Teacher credentialed | 0.98 | 0.07 | -3.91E-01 | 0.68 | 0.08 | -3.28 |
| Female | 0.71 | 0.45 | -1.18E-02 | 0.99 | 0.03 | -0.43 |
| No prior experience | 0.06 | 0.23 | 4.59E-01 | 1.58 | 0.07 | 10.50 |
| 1 – 3 yrs experience | 0.16 | 0.36 | 1.95E-01 | 1.22 | 0.05 | 4.93 |
| Total experience | 13.20 | 9.02 | -3.94E-02 | 0.96 | 0.00 | -15.43 |
| Age | 41.24 | 8.72 | 1.17E+00 | 3.23 | 0.27 | 14.08 |
| Age squared | 1,776.89 | 697.74 | -3.31E-02 | 0.97 | 0.00 | -15.20 |
| Age cubed | 79,332.45 | 43,559.96 | 2.96E-04 | 1.00 | 0.00 | 16.00 |
| Ed, BA or less | 0.10 | 0.30 | 2.57E-01 | 1.29 | 0.05 | 7.34 |
| Ed, MA or more | 0.30 | 0.46 | 2.45E-01 | 1.28 | 0.04 | 8.57 |
| Asian | 0.04 | 0.19 | 3.92E-02 | 1.04 | 0.06 | 0.65 |
| Black | 0.03 | 0.18 | 7.63E-02 | 1.08 | 0.07 | 1.12 |
| Hispanic | 0.09 | 0.29 | -2.89E-02 | 0.97 | 0.04 | -0.72 |
| Am. Indian | 0.01 | 0.09 | 2.73E-01 | 1.31 | 0.16 | 2.26 |
| Race/ethnicity unknown | 0.00 | 0.04 | 8.64E-01 | 2.37 | 0.45 | 4.56 |
| Number of obs | | | 107,706 | | | |
| Chi2 | | | 3,338 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.1b

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Leave Their District:
Grade K-3 Teachers**

| | Mean | St. Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|------------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.08 | 0.27 | -14.18 | | 1.91 | -7.42 |
| Population density | 1,301.87 | 2,150.95 | 3.30E-06 | 1.00 | 0.00 | 0.14 |
| Unemployment rate | 9.09 | 3.37 | 1.04E-02 | 1.01 | 0.01 | 0.94 |
| Ave. wage, all industries | 27,779.93 | 4,809.59 | 2.00E-05 | 1.00 | 0.00 | 1.66 |
| Ave. wage, federal employees | 37,718.21 | 4,580.40 | 9.76E-06 | 1.00 | 0.00 | 1.14 |
| Per capita income | 22,163.24 | 4,656.80 | 7.03E-06 | 1.00 | 0.00 | 0.77 |
| No. Pupils in district | 17,120.33 | 16,285.90 | 3.21E-06 | 1.00 | 0.00 | 0.29 |
| No. pupils in district cubed | 2.60E+13 | 7.66E+13 | 1.50E-15 | 1.00 | 0.00 | 1.59 |
| No. schools in district | 23.07 | 21.41 | -9.07E-03 | 0.99 | 0.01 | -1.09 |
| No. schools in district cubed | 63,114.92 | 193,161.70 | -4.59E-07 | 1.00 | 0.00 | -0.84 |
| Maximum teachers' salary | 50,986.26 | 4,145.82 | -3.10E-06 | 1.00 | 0.00 | -0.39 |
| Rate of enrollment growth | 0.89 | 2.15 | -2.29E-02 | 0.98 | 0.01 | -2.13 |
| Inst. exp. /pupil | 1,795.35 | 159.81 | -4.55E-04 | 1.00 | 0.00 | -2.76 |
| Adm. exp./pupil | 184.92 | 35.15 | 1.10E-05 | 1.00 | 0.00 | 2.68 |
| Fraction nonwhite pupils in district | 0.54 | 0.25 | -3.77E-01 | 0.69 | 0.14 | -1.79 |
| No. pupils in school | 662.57 | 221.70 | -3.37E-04 | 1.00 | 0.00 | -1.55 |
| No. pupils in school cubed | 3.94E+08 | 4.43E+08 | 3.72E-11 | 1.00 | 0.00 | 0.38 |
| Pct. students Black | 6.96 | 10.08 | 1.61E-02 | 1.02 | 0.00 | 5.41 |
| Pct. students Hispanic | 35.43 | 27.23 | 5.54E-03 | 1.01 | 0.00 | 2.21 |
| Pct. students Asian | 9.58 | 12.46 | 2.31E-03 | 1.00 | 0.00 | 0.84 |
| Pct. students Am Indian | 0.57 | 2.60 | -7.48E-03 | 0.99 | 0.01 | -0.71 |
| Pct. students Free lunch eligible | 48.95 | 28.40 | -4.47E-04 | 1.00 | 0.00 | -0.29 |
| Class size | 29.18 | 6.36 | -5.79E-03 | 0.99 | 0.00 | -1.34 |
| Rural | 0.08 | 0.26 | 9.49E-02 | 1.10 | 0.11 | 0.93 |
| Urban | 0.31 | 0.46 | -2.97E-03 | 1.00 | 0.05 | -0.06 |
| Teacher credentialed | 0.99 | 0.08 | -4.48E-01 | 0.64 | 0.12 | -2.31 |
| Female | 0.92 | 0.27 | -6.40E-02 | 0.94 | 0.06 | -0.93 |
| No prior experience | 0.06 | 0.23 | 4.00E-01 | 1.49 | 0.11 | 5.25 |
| 1 - 3 yrs experience | 0.16 | 0.36 | 1.04E-01 | 1.11 | 0.08 | 1.48 |
| Total experience | 12.56 | 8.70 | -2.61E-02 | 0.97 | 0.00 | -5.89 |
| Age | 40.72 | 8.82 | 1.18E-00 | 3.25 | 0.47 | 8.08 |
| Age squared | 1,736.30 | 702.28 | -3.40E-02 | 0.97 | 0.00 | -8.90 |
| Age cubed | 76,872.61 | 43,624.84 | 3.06E-04 | 1.00 | 0.00 | 9.45 |
| Ed, BA or less | 0.12 | 0.32 | 1.89E-01 | 1.21 | 0.07 | 3.17 |
| Ed, MA or more | 0.24 | 0.43 | 1.76E-01 | 1.19 | 0.06 | 3.40 |
| Asian | 0.05 | 0.21 | -2.25E-01 | 0.80 | 0.08 | -2.15 |
| Black | 0.03 | 0.16 | 9.38E-02 | 1.10 | 0.13 | 0.79 |
| Hispanic | 0.12 | 0.32 | -9.17E-04 | 1.00 | 0.06 | -0.02 |
| Am. Indian | 0.01 | 0.08 | 4.01E-01 | 1.49 | 0.34 | 1.75 |
| Race/ethnicity unknown | 0.00 | 0.04 | 1.12E-00 | 3.06 | 0.89 | 3.87 |
| Number of obs | | | 38,708 | | | |
| Chi2 | | | 1,167 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.1c

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Leave Their District:
Grade 4-6 Teachers**

| | Mean | St.Dev | Coeff. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|------------|-----------|---------------|------------|---------|
| Dependent Variable/Constant | 0.08 | 0.26 | -15.36 | | 2.53 | -6.06 |
| Population density | 1,238.91 | 2,061.82 | 7.27E-06 | 1.00 | 0.00 | 0.22 |
| Unemployment rate | 9.24 | 3.53 | -4.36E-03 | 1.00 | 0.01 | -0.32 |
| Ave. wage, all industries | 27,565.42 | 4,823.67 | 2.01E-05 | 1.00 | 0.00 | 1.39 |
| Ave. wage, federal employees | 37,515.98 | 4,695.06 | -2.91E-06 | 1.00 | 0.00 | -0.30 |
| Per capita income | 21,946.18 | 4,577.10 | 5.74E-06 | 1.00 | 0.00 | 0.48 |
| No. Pupils in district | 16,228.50 | 15,322.35 | -3.80E-06 | 1.00 | 0.00 | -0.26 |
| No. pupils in district cubed | 2.19E+13 | 6.77E+13 | 4.47E-16 | 1.00 | 0.00 | 0.35 |
| No. schools in district | 22.11 | 20.62 | 1.73E-04 | 1.00 | 0.01 | 0.02 |
| No. schools in district cubed | 57,078.51 | 184,226.70 | -1.43E-07 | 1.00 | 0.00 | -0.19 |
| Maximum teachers' salary | 50,881.63 | 4,168.58 | -1.74E-05 | 1.00 | 0.00 | -1.78 |
| Rate of enrollment growth | 0.91 | 2.17 | -1.97E-02 | 0.98 | 0.01 | -1.42 |
| Inst. exp. /pupil | 1,793.80 | 155.80 | -8.19E-05 | 1.00 | 0.00 | -0.39 |
| Adm. exp./pupil | 177.57 | 37.74 | -1.35E-05 | 1.00 | 0.00 | -0.93 |
| Fraction nonwhite pupils in district | 0.52 | 0.25 | 4.35E-03 | 1.00 | 0.27 | 0.02 |
| No. pupils in school | 675.10 | 227.81 | -8.48E-04 | 1.00 | 0.00 | -2.93 |
| No. pupils in school cubed | 4.23E+08 | 5.44E+08 | 3.22E-10 | 1.00 | 0.00 | 3.24 |
| Pct. students Black | 6.61 | 9.78 | 1.23E-02 | 1.01 | 0.00 | 2.95 |
| Pct. students Hispanic | 33.66 | 26.59 | 1.40E-03 | 1.00 | 0.00 | 0.43 |
| Pct. students Asian | 9.53 | 12.37 | 2.65E-03 | 1.00 | 0.00 | 0.74 |
| Pct. students Am Indian | 0.60 | 2.57 | 2.60E-03 | 1.00 | 0.01 | 0.30 |
| Pct. students Free lunch eligible | 46.53 | 27.92 | 3.51E-03 | 1.00 | 0.00 | 1.70 |
| Class size | 29.82 | 5.69 | -5.00E-03 | 1.00 | 0.01 | -0.88 |
| Rural | 0.08 | 0.27 | 1.13E-01 | 1.12 | 0.14 | 0.92 |
| Urban | 0.30 | 0.46 | -3.65E-02 | 0.96 | 0.07 | -0.52 |
| Teacher credentialed | 1.00 | 0.07 | -2.60E-01 | 0.77 | 0.20 | -0.99 |
| Female | 0.77 | 0.42 | 3.86E-02 | 1.04 | 0.07 | 0.58 |
| No prior experience | 0.06 | 0.24 | 3.58E-01 | 1.43 | 0.15 | 3.39 |
| 1 – 3 yrs experience | 0.17 | 0.37 | 2.18E-01 | 1.24 | 0.11 | 2.38 |
| Total experience | 12.31 | 8.75 | -2.64E-02 | 0.97 | 0.01 | -4.51 |
| Age | 40.81 | 8.68 | 1.32E-00 | 3.75 | 0.75 | 6.65 |
| Age squared | 1,741.05 | 691.49 | -3.78E-02 | 0.96 | 0.01 | -7.26 |
| Age cubed | 77,028.18 | 42,963.40 | 3.40E-04 | 1.00 | 0.00 | 7.68 |
| Ed, BA or less | 0.11 | 0.31 | 1.07E-01 | 1.11 | 0.09 | 1.29 |
| Ed, MA or more | 0.27 | 0.44 | 3.68E-01 | 1.45 | 0.10 | 5.51 |
| Asian | 0.03 | 0.18 | 3.11E-02 | 1.03 | 0.15 | 0.22 |
| Black | 0.03 | 0.18 | 9.92E-02 | 1.10 | 0.17 | 0.66 |
| Hispanic | 0.08 | 0.27 | -3.68E-03 | 1.00 | 0.09 | -0.04 |
| Am. Indian | 0.01 | 0.08 | 3.68E-01 | 1.45 | 0.41 | 1.31 |
| Race/ethnicity unknown | 0.00 | 0.04 | 3.73E-01 | 1.45 | 0.79 | 0.69 |
| Number of obs | | | 20,377 | | | |
| Chi2 | | | 636 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.1d

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Leave Their District:
Grade 6-8 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|------------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.10 | 0.30 | -13.00 | | 2.43 | -5.34 |
| Population density | 1,361.80 | 2,456.00 | -7.02E-06 | 1.00 | 0.00 | -0.24 |
| Unemployment rate | 9.08 | 3.38 | 4.12E-03 | 1.00 | 0.01 | 0.28 |
| Ave. wage, all industries | 27,862.58 | 4,918.96 | 3.82E-06 | 1.00 | 0.00 | 0.24 |
| Ave. wage, federal employees | 37,860.62 | 4,561.39 | 1.16E-05 | 1.00 | 0.00 | 1.02 |
| Per capita income | 22,364.19 | 4,863.28 | 1.99E-05 | 1.00 | 0.00 | 1.80 |
| No. Pupils in district | 17,406.77 | 16,817.55 | -1.57E-05 | 1.00 | 0.00 | -1.12 |
| No. pupils in district cubed | 2.83E+13 | 8.30E+13 | 2.65E-15 | 1.00 | 0.00 | 2.45 |
| No. schools in district | 22.90 | 22.28 | 3.01E-03 | 1.00 | 0.01 | 0.28 |
| No. schools in district cubed | 69,377.52 | 217,986.60 | 4.74E-08 | 1.00 | 0.00 | 0.07 |
| Maximum teachers' salary | 50,943.00 | 4,118.56 | 7.12E-06 | 1.00 | 0.00 | 0.75 |
| Rate of enrollment growth | 0.90 | 2.17 | -1.20E-02 | 0.99 | 0.01 | -0.87 |
| Inst. exp. /pupil | 1,808.17 | 164.51 | -2.09E-04 | 1.00 | 0.00 | -1.02 |
| Adm. exp./pupil | 182.94 | 37.21 | -2.66E-05 | 1.00 | 0.00 | -1.28 |
| Fraction nonwhite pupils in district | 0.52 | 0.25 | -4.23E-01 | 0.65 | 0.24 | -1.17 |
| No. pupils in school | 956.24 | 405.11 | -1.69E-04 | 1.00 | 0.00 | -1.20 |
| No. pupils in school cubed | 1.48E+09 | 4.20E+09 | 8.67E-12 | 1.00 | 0.00 | 1.32 |
| Pct. students Black | 6.83 | 9.48 | 2.45E-02 | 1.02 | 0.00 | 5.38 |
| Pct. students Hispanic | 31.21 | 24.13 | 5.38E-03 | 1.01 | 0.00 | 1.24 |
| Pct. students Asian | 11.12 | 12.87 | -1.97E-03 | 1.00 | 0.00 | -0.48 |
| Pct. students Am Indian | 0.62 | 2.38 | 7.63E-03 | 1.01 | 0.01 | 0.68 |
| Pct. students Free lunch eligible | 38.88 | 24.01 | -9.39E-04 | 1.00 | 0.00 | -0.41 |
| Class size | 33.27 | 20.36 | -2.45E-03 | 1.00 | 0.00 | -1.68 |
| Rural | 0.07 | 0.26 | 3.22E-01 | 1.38 | 0.17 | 2.58 |
| Urban | 0.30 | 0.46 | 5.76E-02 | 1.06 | 0.08 | 0.75 |
| Teacher credentialed | 1.00 | 0.07 | 5.69E-02 | 1.06 | 0.28 | 0.21 |
| Female | 0.59 | 0.49 | 6.31E-02 | 1.07 | 0.06 | 1.22 |
| No prior experience | 0.06 | 0.25 | 6.02E-01 | 1.83 | 0.18 | 6.25 |
| 1 - 3 yrs experience | 0.18 | 0.38 | 9.53E-02 | 1.10 | 0.09 | 1.15 |
| Total experience | 12.93 | 9.11 | -4.36E-02 | 0.96 | 0.01 | -8.07 |
| Age | 41.21 | 8.63 | 9.25E-01 | 2.52 | 0.47 | 4.93 |
| Age squared | 1,772.74 | 691.15 | -2.62E-02 | 0.97 | 0.00 | -5.30 |
| Age cubed | 78,986.75 | 43,169.55 | 2.35E-04 | 1.00 | 0.00 | 5.55 |
| Ed, BA or less | 0.10 | 0.30 | 3.58E-01 | 1.43 | 0.11 | 4.69 |
| Ed, MA or more | 0.32 | 0.47 | 2.63E-01 | 1.30 | 0.08 | 4.51 |
| Asian | 0.04 | 0.19 | 3.22E-01 | 1.38 | 0.17 | 2.54 |
| Black | 0.04 | 0.19 | -1.21E-01 | 0.89 | 0.13 | -0.81 |
| Hispanic | 0.07 | 0.25 | 1.77E-02 | 1.02 | 0.10 | 0.18 |
| Am. Indian | 0.01 | 0.09 | -2.92E-02 | 0.97 | 0.28 | -0.10 |
| Race/ethnicity unknown | 0.00 | 0.04 | 9.72E-01 | 2.64 | 1.11 | 2.31 |
| Number of obs | | | 19,549 | | | |
| Chi2 | | | 765 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.1e

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Leave Their District:
Grade 9-12 Teachers in Math & Science**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|------------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.10 | 0.31 | -9.26 | | 3.42 | -2.70 |
| Population density | 1426.23 | 2464.34 | 7.27E-06 | 1.00 | 0.00 | 0.85 |
| Unemployment rate | 8.87 | 3.33 | -4.36E-03 | 1.01 | 0.02 | 0.49 |
| Ave. wage, all industries | 28,195.93 | 5,046.64 | 2.01E-05 | 1.00 | 0.00 | 2.17 |
| Ave. wage, federal employees | 38,054.26 | 4,574.24 | -2.91E-06 | 1.00 | 0.00 | 1.44 |
| Per capita income | 22,596.29 | 4,811.72 | 5.74E-06 | 1.00 | 0.00 | 0.37 |
| No. Pupils in district | 18,115.81 | 15,702.60 | -3.80E-06 | 1.00 | 0.00 | -1.93 |
| No. pupils in district cubed | 2.55E+13 | 7.19E+13 | 4.47E-16 | 1.00 | 0.00 | 0.42 |
| No. schools in district | 22.23 | 22.40 | 1.73E-04 | 1.02 | 0.01 | 2.03 |
| No. schools in district cubed | 68,208.58 | 218,141.50 | -1.43E-07 | 1.00 | 0.00 | -1.40 |
| Maximum teachers' salary | 51,348.34 | 4,021.73 | -1.74E-05 | 1.00 | 0.00 | -1.63 |
| Rate of enrollment growth | 1.07 | 2.20 | -1.97E-02 | 0.98 | 0.02 | -1.40 |
| Inst. exp. /pupil | 1,860.56 | 197.88 | -8.19E-05 | 1.00 | 0.00 | -0.24 |
| Adm. exp./pupil | 177.57 | 37.74 | -1.35E-05 | 1.00 | 0.00 | -2.07 |
| Fraction nonwhite pupils in district | 0.51 | 0.24 | 4.35E-03 | 0.62 | 0.29 | -1.03 |
| No. pupils in school | 1,846.79 | 811.68 | -8.48E-04 | 1.00 | 0.00 | -1.75 |
| No. pupils in school cubed | 1.01E+10 | 1.32E+10 | 3.22E-10 | 1.00 | 0.00 | 1.41 |
| Pct. students Black | 6.73 | 9.43 | 1.23E-02 | 1.01 | 0.01 | 2.01 |
| Pct. students Hispanic | 29.10 | 22.59 | 1.40E-03 | 1.01 | 0.00 | 2.22 |
| Pct. students Asian | 12.19 | 13.74 | 2.65E-03 | 0.99 | 0.01 | -0.98 |
| Pct. students Am Indian | 0.69 | 2.16 | 2.60E-03 | 1.00 | 0.02 | -0.13 |
| Pct. students Free lunch eligible | 22.73 | 16.45 | 3.51E-03 | 1.00 | 0.00 | 0.13 |
| Class size | 31.35 | 13.34 | -5.00E-03 | 1.00 | 0.00 | 0.26 |
| Rural | 0.07 | 0.25 | 1.13E-01 | 1.21 | 0.20 | 1.14 |
| Urban | 0.29 | 0.45 | -3.65E-02 | 1.10 | 0.10 | 1.00 |
| Teacher credentialed | 1.00 | 0.07 | -2.60E-01 | 0.79 | 0.32 | -0.58 |
| Female | 0.36 | 0.48 | 3.86E-02 | 1.16 | 0.09 | 1.77 |
| No prior experience | 0.06 | 0.23 | 3.58E-01 | 1.54 | 0.23 | 2.93 |
| 1 - 3 yrs experience | 0.16 | 0.37 | 2.18E-01 | 1.31 | 0.17 | 2.09 |
| Total experience | 13.79 | 9.30 | -2.64E-02 | 0.94 | 0.01 | -6.45 |
| Age | 41.23 | 8.76 | 1.32E+00 | 1.91 | 0.51 | 2.44 |
| Age squared | 1,776.49 | 704.49 | -3.78E-02 | 0.98 | 0.01 | -2.68 |
| Age cubed | 79,379.75 | 44,191.15 | 3.40E-04 | 1.00 | 0.00 | 2.91 |
| Ed, BA or less | 0.09 | 0.29 | 1.07E-01 | 1.39 | 0.16 | 2.83 |
| Ed, MA or more | 0.40 | 0.49 | 3.68E-01 | 1.03 | 0.10 | 0.36 |
| Asian | 0.05 | 0.22 | 3.11E-02 | 1.23 | 0.19 | 1.31 |
| Black | 0.03 | 0.16 | 9.92E-02 | 1.22 | 0.26 | 0.92 |
| Hispanic | 0.06 | 0.24 | -3.68E-03 | 0.83 | 0.13 | -1.22 |
| Am. Indian | 0.01 | 0.09 | 3.68E-01 | 1.83 | 0.63 | 1.75 |
| Race/ethnicity unknown | 0.00 | 0.04 | 3.73E-01 | 2.47 | 1.42 | 1.57 |
| Number of obs | | | 8,142 | | | |
| Chi2 | | | 456 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.1f

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Leave Their District:
Grade 9-12 Teachers in Other Subjects**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|------------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.08 | 0.28 | -18.9 | | 2.5 | -7.5 |
| Population density | 1,352.39 | 2,400.04 | 4.07E-05 | 1.00 | 0.00 | 1.53 |
| Unemployment rate | 9.06 | 3.43 | 7.47E-03 | 1.01 | 0.01 | 0.56 |
| Ave. wage, all industries | 27,885.45 | 5,055.61 | 2.12E-05 | 1.00 | 0.00 | 1.64 |
| Ave. wage, federal employees | 37,795.78 | 4,692.81 | -4.61E-07 | 1.00 | 0.00 | -0.05 |
| Per capita income | 22,334.53 | 4,791.17 | -3.02E-06 | 1.00 | 0.00 | -0.31 |
| No. Pupils in district | 17,763.39 | 15,728.99 | -2.77E-05 | 1.00 | 0.00 | -3.19 |
| No. pupils in district cubed | 2.51E+13 | 7.25E+13 | 3.28E-15 | 1.00 | 0.00 | 3.93 |
| No. schools in district | 21.84 | 22.20 | 1.49E-02 | 1.02 | 0.01 | 2.30 |
| No. schools in district cubed | 66,037.49 | 213,323.10 | -1.13E-06 | 1.00 | 0.00 | -2.27 |
| Maximum teachers' salary | 51,185.26 | 4,055.68 | -1.74E-05 | 1.00 | 0.00 | -1.84 |
| Rate of enrollment growth | 1.08 | 2.22 | -3.74E-03 | 1.00 | 0.01 | -0.30 |
| Inst. exp. /pupil | 1,855.31 | 196.12 | 3.00E-04 | 1.00 | 0.00 | 1.87 |
| Adm. exp./pupil | 174.65 | 34.46 | 4.16E-06 | 1.00 | 0.00 | 0.78 |
| Fraction nonwhite pupils in district | 0.51 | 0.24 | 4.52E-01 | 1.57 | 0.47 | 1.51 |
| No. pupils in school | 1,821.49 | 818.44 | -5.46E-06 | 1.00 | 0.00 | -0.08 |
| No. pupils in school cubed | 9.84E+09 | 1.30E+10 | 9.95E-13 | 1.00 | 0.00 | 0.28 |
| Pct. students Black | 6.51 | 9.28 | 5.65E-03 | 1.01 | 0.00 | 1.51 |
| Pct. students Hispanic | 29.65 | 22.89 | -4.74E-04 | 1.00 | 0.00 | -0.14 |
| Pct. students Asian | 11.49 | 13.26 | -8.04E-03 | 0.99 | 0.00 | -2.34 |
| Pct. students Am Indian | 0.72 | 2.12 | -9.97E-03 | 0.99 | 0.01 | -0.70 |
| Pct. students Free lunch eligible | 23.28 | 16.66 | 2.60E-04 | 1.00 | 0.00 | 0.12 |
| Class size | 31.50 | 16.33 | -3.25E-03 | 1.00 | 0.00 | -1.78 |
| Rural | 0.08 | 0.27 | 7.98E-02 | 1.08 | 0.12 | 0.70 |
| Urban | 0.29 | 0.46 | 7.02E-02 | 1.07 | 0.07 | 1.06 |
| Teacher credentialed | 1.00 | 0.06 | -7.91E-01 | 0.45 | 0.12 | -2.98 |
| Female | 0.50 | 0.50 | 1.47E-01 | 1.16 | 0.06 | 2.81 |
| No prior experience | 0.05 | 0.22 | 4.72E-01 | 1.60 | 0.16 | 4.67 |
| 1 - 3 yrs experience | 0.14 | 0.34 | 3.24E-01 | 1.38 | 0.13 | 3.57 |
| Total experience | 15.26 | 9.32 | -5.13E-02 | 0.95 | 0.01 | -9.63 |
| Age | 42.65 | 8.47 | 1.48E+00 | 4.40 | 0.87 | 7.51 |
| Age squared | 1,890.85 | 686.43 | -4.04E-02 | 0.96 | 0.00 | -7.93 |
| Age cubed | 86,429.60 | 43,368.87 | 3.55E-04 | 1.00 | 0.00 | 8.30 |
| Ed, BA or less | 0.08 | 0.27 | 4.06E-01 | 1.50 | 0.13 | 4.85 |
| Ed, MA or more | 0.40 | 0.49 | 2.42E-01 | 1.27 | 0.08 | 3.86 |
| Asian | 0.03 | 0.16 | 1.25E-01 | 1.13 | 0.18 | 0.78 |
| Black | 0.03 | 0.18 | 1.00E-01 | 1.11 | 0.19 | 0.58 |
| Hispanic | 0.09 | 0.28 | -9.20E-03 | 0.99 | 0.10 | -0.09 |
| Am. Indian | 0.01 | 0.10 | 7.49E-02 | 1.08 | 0.29 | 0.28 |
| Race/ethnicity unknown | 0.00 | 0.04 | 3.66E-01 | 1.44 | 0.75 | 0.70 |
| Number of obs | | | 20,930 | | | |
| Chi2 | | | 859 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.2a

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Leave Their District:
All Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z- score |
|--------------------------------------|-----------|------------|-----------|---------------|---------------|-------------|
| Dependent Variable/Constant | 0.09 | 0.29 | -12.03 | | 1.05 | -11.44 |
| Population density | 1,326.99 | 2,221.63 | 8.12E-06 | 1.00 | 0.00 | 0.61 |
| Unemployment rate | 8.43 | 3.73 | 1.49E-02 | 1.01 | 0.01 | 2.63 |
| Ave. wage, all industries | 28,512.38 | 5,422.73 | 1.58E-05 | 1.00 | 0.00 | 2.85 |
| Ave. wage, federal employees | 38,901.54 | 5,400.41 | 1.08E-06 | 1.00 | 0.00 | 0.28 |
| Per capita income | 23,176.38 | 5,219.97 | 1.16E-05 | 1.00 | 0.00 | 2.24 |
| No. Pupils in district | 17,641.99 | 16,517.68 | -8.16E-06 | 1.00 | 0.00 | -1.82 |
| No. pupils in district cubed | 2.77E+13 | 8.34E+13 | 1.52E-15 | 1.00 | 0.00 | 3.76 |
| No. schools in district | 22.55 | 21.68 | 6.83E-04 | 1.00 | 0.00 | 0.19 |
| No. schools in district cubed | 64,623.32 | 207,910.10 | -2.83E-07 | 1.00 | 0.00 | -1.09 |
| Maximum teachers' salary | 51,069.25 | 4,140.15 | -2.77E-05 | 1.00 | 0.00 | -6.53 |
| Rate of enrollment growth | 1.25 | 2.17 | 5.37E-06 | 1.00 | 0.01 | 0.00 |
| Inst. exp. /pupil | 1,871.41 | 176.14 | 1.27E-05 | 1.00 | 0.00 | 0.14 |
| Adm. exp./pupil | 198.30 | 34.60 | 1.00E-03 | 1.00 | 0.00 | 2.20 |
| Fraction nonwhite pupils in district | 0.54 | 0.25 | 8.22E-02 | 1.09 | 0.14 | 0.65 |
| No. pupils in school | 1,048.55 | 705.37 | 1.04E-04 | 1.00 | 0.00 | 2.95 |
| No. pupils in school cubed | 3.32E+09 | 8.63E+09 | -4.56E-12 | 1.00 | 0.00 | -2.25 |
| Pct. students Black | 7.32 | 9.76 | 1.39E-02 | 1.01 | 0.00 | 8.02 |
| Pct. students Hispanic | 34.36 | 25.93 | 3.77E-03 | 1.00 | 0.00 | 2.59 |
| Pct. students Asian | 11.00 | 12.99 | -2.58E-03 | 1.00 | 0.00 | -1.58 |
| Pct. students Am Indian | 0.94 | 2.61 | 7.59E-03 | 1.01 | 0.00 | 1.76 |
| Pct. students Free lunch eligible | 41.59 | 27.51 | -1.50E-03 | 1.00 | 0.00 | -1.70 |
| Class size | 30.98 | 14.12 | -4.38E-04 | 1.00 | 0.00 | -0.52 |
| Rural | 0.06 | 0.23 | 3.15E-02 | 1.03 | 0.07 | 0.50 |
| Urban | 0.29 | 0.45 | -1.08E-01 | 0.90 | 0.03 | -3.51 |
| Teacher credentialed | 0.98 | 0.13 | -4.53E-01 | 0.64 | 0.04 | -7.06 |
| Female | 0.71 | 0.45 | 3.50E-02 | 1.04 | 0.03 | 1.35 |
| No prior experience | 0.06 | 0.24 | 3.24E-01 | 1.38 | 0.06 | 7.87 |
| 1 – 3 yrs experience | 0.17 | 0.38 | 1.70E-01 | 1.19 | 0.04 | 4.72 |
| Total experience | 13.05 | 9.11 | -4.38E-02 | 0.96 | 0.00 | -18.71 |
| Age | 41.21 | 8.90 | 9.62E-01 | 2.62 | 0.21 | 11.88 |
| Age squared | 1,777.40 | 712.09 | -2.74E-02 | 0.97 | 0.00 | -12.96 |
| Age cubed | 79,548.89 | 44,463.21 | 2.45E-04 | 1.00 | 0.00 | 13.71 |
| Ed, BA or less | 0.11 | 0.31 | 2.13E-01 | 1.24 | 0.04 | 6.34 |
| Ed, MA or more | 0.30 | 0.46 | 3.01E-01 | 1.35 | 0.04 | 10.95 |
| Asian | 0.04 | 0.20 | 4.26E-02 | 1.04 | 0.06 | 0.78 |
| Black | 0.03 | 0.17 | 1.52E-01 | 1.16 | 0.08 | 2.31 |
| Hispanic | 0.10 | 0.30 | -4.96E-02 | 0.95 | 0.04 | -1.32 |
| Am. Indian | 0.01 | 0.09 | 3.48E-01 | 1.42 | 0.16 | 3.06 |
| Race/ethnicity unknown | 0.00 | 0.04 | 4.94E-01 | 1.64 | 0.35 | 2.31 |
| Number of obs | | | 109,663 | | | |
| Chi2 | | | 3,481 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.2b

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Leave Their District:
Grade K-3 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|-----------|-----------|---------------|------------|---------|
| Dependent Variable/Constant | 0.08 | 0.28 | -11.66 | | 1.78 | -6.55 |
| Population density | 1,328.97 | 2,145.02 | 3.80E-05 | 1.00 | 0.00 | 1.67 |
| Unemployment rate | 8.41 | 3.66 | -8.59E-03 | 0.99 | 0.01 | -0.97 |
| Ave. wage, all industries | 28,473.19 | 5,285.51 | 1.83E-05 | 1.00 | 0.00 | 2.08 |
| Ave. wage, federal employees | 38,902.86 | 5,326.50 | -1.23E-06 | 1.00 | 0.00 | -0.20 |
| Per capita income | 23,088.21 | 5,091.65 | 2.66E-06 | 1.00 | 0.00 | 0.33 |
| No. Pupils in district | 17,643.65 | 16,789.46 | 9.28E-06 | 1.00 | 0.00 | 1.05 |
| No. pupils in district cubed | 2.86E+13 | 8.55E+13 | 9.30E-16 | 1.00 | 0.00 | 1.21 |
| No. schools in district | 23.18 | 21.52 | -9.80E-03 | 0.99 | 0.01 | -1.36 |
| No. schools in district cubed | 64,632.60 | 2.02E+05 | -5.40E-07 | 1.00 | 0.00 | -1.12 |
| Maximum teachers' salary | 51,059.41 | 4,182.19 | -4.10E-05 | 1.00 | 0.00 | -5.58 |
| Rate of enrollment growth | 1.15 | 2.13 | -4.01E-03 | 1.00 | 0.01 | -0.37 |
| Inst. exp. /pupil | 1,851.29 | 159.98 | -2.57E-04 | 1.00 | 0.00 | -1.59 |
| Adm. exp./pupil | 196.30 | 33.22 | 2.12E-03 | 1.00 | 0.00 | 2.62 |
| Fraction nonwhite pupils in district | 0.55 | 0.25 | 1.76E-01 | 1.19 | 0.23 | 0.90 |
| No. pupils in school | 673.53 | 228.67 | 1.60E-04 | 1.00 | 0.00 | 0.77 |
| No. pupils in school cubed | 4.18E+08 | 4.80E+08 | -7.21E-11 | 1.00 | 0.00 | -0.89 |
| Pct. students Black | 7.57 | 10.24 | 1.23E-02 | 1.01 | 0.00 | 4.35 |
| Pct. students Hispanic | 37.45 | 27.71 | 3.13E-03 | 1.00 | 0.00 | 1.36 |
| Pct. students Asian | 9.94 | 12.51 | -1.31E-03 | 1.00 | 0.00 | -0.51 |
| Pct. students Am Indian | 0.88 | 2.82 | 1.97E-03 | 1.00 | 0.01 | 0.27 |
| Pct. students Free lunch eligible | 51.00 | 28.83 | -6.67E-04 | 1.00 | 0.00 | -0.46 |
| Class size | 29.14 | 5.79 | -2.35E-03 | 1.00 | 0.00 | -0.57 |
| Rural | 0.06 | 0.23 | 1.36E-01 | 1.15 | 0.11 | 1.40 |
| Urban | 0.30 | 0.46 | -1.02E-01 | 0.90 | 0.05 | -1.97 |
| Teacher credentialed | 0.98 | 0.13 | -3.36E-01 | 0.71 | 0.08 | -3.11 |
| Female | 0.92 | 0.27 | -1.55E-01 | 0.86 | 0.05 | -2.44 |
| No prior experience | 0.06 | 0.24 | 1.65E-01 | 1.18 | 0.09 | 2.28 |
| 1 - 3 yrs experience | 0.18 | 0.38 | 1.39E-01 | 1.15 | 0.07 | 2.28 |
| Total experience | 12.44 | 8.78 | -3.49E-02 | 0.97 | 0.00 | -8.22 |
| Age | 40.67 | 8.99 | 1.06E+00 | 2.88 | 0.39 | 7.81 |
| Age squared | 1,734.97 | 715.24 | -3.00E-02 | 0.97 | 0.00 | -8.44 |
| Age cubed | 76,959.71 | 44,418.44 | 2.66E-04 | 1.00 | 0.00 | 8.79 |
| Ed, BA or less | 0.12 | 0.32 | 1.52E-01 | 1.16 | 0.06 | 2.74 |
| Ed, MA or more | 0.24 | 0.42 | 2.26E-01 | 1.25 | 0.06 | 4.66 |
| Asian | 0.05 | 0.22 | -8.79E-02 | 0.92 | 0.08 | -0.95 |
| Black | 0.03 | 0.16 | 5.70E-02 | 1.06 | 0.11 | 0.53 |
| Hispanic | 0.13 | 0.33 | -1.13E-01 | 0.89 | 0.05 | -1.90 |
| Am. Indian | 0.01 | 0.08 | 5.21E-01 | 1.68 | 0.35 | 2.54 |
| Race/ethnicity unknown | 0.00 | 0.04 | 9.33E-01 | 2.54 | 0.85 | 2.79 |
| Number of obs | | | 39,395 | | | |
| Chi2 | | | 1,296 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.2c

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Leave Their District:
Grade 4-6 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|-----------|-----------|---------------|------------|---------|
| Dependent Variable/Constant | 0.08 | 0.27 | -13.04 | | 2.52 | -5.17 |
| Population density | 1,251.44 | 2,062.76 | 1.81E-05 | 1.00 | 0.00 | 0.56 |
| Unemployment rate | 8.62 | 3.88 | 2.10E-02 | 1.02 | 0.01 | 1.87 |
| Ave. wage, all industries | 28,203.97 | 5,331.28 | 2.49E-05 | 1.00 | 0.00 | 2.02 |
| Ave. wage, federal employees | 38,583.69 | 5,484.08 | -2.07E-06 | 1.00 | 0.00 | -0.25 |
| Per capita income | 22,836.62 | 5,064.88 | 2.03E-05 | 1.00 | 0.00 | 1.76 |
| No. Pupils in district | 16,614.69 | 15,816.90 | 5.19E-06 | 1.00 | 0.00 | 0.41 |
| No. pupils in district cubed | 2.40E+13 | 7.49E+13 | 2.89E-16 | 1.00 | 0.00 | 0.26 |
| No. schools in district | 22.13 | 20.81 | -1.82E-03 | 1.00 | 0.01 | -0.18 |
| No. schools in district cubed | 58,488.14 | 1.91E+05 | -7.44E-07 | 1.00 | 0.00 | -1.08 |
| Maximum teachers' salary | 50,842.75 | 4,179.41 | -3.19E-05 | 1.00 | 0.00 | -3.31 |
| Rate of enrollment growth | 1.18 | 2.17 | -2.51E-03 | 1.00 | 0.01 | -0.19 |
| Inst. exp. /pupil | 1,850.67 | 159.08 | -2.14E-04 | 1.00 | 0.00 | -0.95 |
| Adm. exp./pupil | 196.23 | 32.57 | -1.47E-03 | 1.00 | 0.00 | -1.41 |
| Fraction nonwhite pupils in district | 0.54 | 0.25 | 1.88E-01 | 1.21 | 0.32 | 0.71 |
| No. pupils in school | 682.61 | 232.26 | -7.70E-04 | 1.00 | 0.00 | -3.18 |
| No. pupils in school cubed | 4.40E+08 | 5.60E+08 | 1.84E-10 | 1.00 | 0.00 | 2.28 |
| Pct. students Black | 7.19 | 9.87 | 7.70E-03 | 1.01 | 0.00 | 1.91 |
| Pct. students Hispanic | 35.45 | 27.07 | 4.49E-04 | 1.00 | 0.00 | 0.14 |
| Pct. students Asian | 9.96 | 12.50 | -7.38E-03 | 0.99 | 0.00 | -2.08 |
| Pct. students Am Indian | 0.92 | 2.69 | 4.75E-03 | 1.00 | 0.01 | 0.47 |
| Pct. students Free lunch eligible | 48.69 | 28.25 | 1.61E-03 | 1.00 | 0.00 | 0.81 |
| Class size | 29.86 | 5.12 | -3.47E-03 | 1.00 | 0.01 | -0.53 |
| Rural | 0.06 | 0.24 | -2.75E-02 | 0.97 | 0.14 | -0.19 |
| Urban | 0.29 | 0.45 | 1.43E-02 | 1.01 | 0.07 | 0.21 |
| Teacher credentialed | 0.99 | 0.11 | -5.16E-01 | 0.60 | 0.10 | -3.02 |
| Female | 0.77 | 0.42 | 7.80E-02 | 1.08 | 0.07 | 1.18 |
| No prior experience | 0.06 | 0.23 | 3.30E-01 | 1.39 | 0.15 | 3.16 |
| 1 - 3 yrs experience | 0.17 | 0.38 | 2.92E-02 | 1.03 | 0.09 | 0.34 |
| Total experience | 12.35 | 8.76 | -3.28E-02 | 0.97 | 0.01 | -5.61 |
| Age | 40.93 | 8.81 | 1.16E+00 | 3.20 | 0.62 | 5.97 |
| Age squared | 1,753.19 | 702.93 | -3.32E-02 | 0.97 | 0.00 | -6.53 |
| Age cubed | 77,924.33 | 43,757.35 | 2.97E-04 | 1.00 | 0.00 | 6.89 |
| Ed, BA or less | 0.10 | 0.31 | 2.27E-01 | 1.26 | 0.10 | 2.90 |
| Ed, MA or more | 0.26 | 0.44 | 2.59E-01 | 1.30 | 0.09 | 3.84 |
| Asian | 0.03 | 0.18 | 2.77E-02 | 1.03 | 0.14 | 0.20 |
| Black | 0.03 | 0.18 | 8.53E-02 | 1.09 | 0.16 | 0.57 |
| Hispanic | 0.09 | 0.28 | 4.19E-02 | 1.04 | 0.10 | 0.45 |
| Am. Indian | 0.01 | 0.09 | 1.92E-01 | 1.21 | 0.37 | 0.63 |
| Race/ethnicity unknown | 0.00 | 0.03 | -5.30E-02 | 0.95 | 0.65 | -0.08 |
| Number of obs | | | 20,200 | | | |
| Chi2 | | | 661 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.2d

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Leave Their District:
Grade 6-8 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|-----------|-----------|---------------|------------|---------|
| Dependent Variable/Constant | 0.10 | 0.30 | -8.66 | | 2.40 | -3.61 |
| Population density | 1,350.91 | 2,372.02 | -4.23E-06 | 1.00 | 0.00 | -0.14 |
| Unemployment rate | 8.42 | 3.67 | 2.97E-02 | 1.03 | 0.01 | 2.69 |
| Ave. wage, all industries | 28,546.42 | 5,409.31 | 1.18E-05 | 1.00 | 0.00 | 0.97 |
| Ave. wage, federal employees | 38,979.67 | 5,322.01 | 7.54E-06 | 1.00 | 0.00 | 0.89 |
| Per capita income | 23,284.58 | 5,340.96 | 1.55E-05 | 1.00 | 0.00 | 1.50 |
| No. Pupils in district | 17,924.59 | 17,319.02 | -2.66E-06 | 1.00 | 0.00 | -0.24 |
| No. pupils in district cubed | 3.10E+13 | 9.20E+13 | 1.40E-15 | 1.00 | 0.00 | 1.50 |
| No. schools in district | 23.03 | 22.29 | -5.90E-03 | 0.99 | 0.01 | -0.67 |
| No. schools in district cubed | 7.00E+04 | 2.22E+05 | 1.89E-07 | 1.00 | 0.00 | 0.30 |
| Maximum teachers' salary | 50,974.12 | 4,072.61 | -2.78E-05 | 1.00 | 0.00 | -3.03 |
| Rate of enrollment growth | 1.23 | 2.18 | -1.41E-02 | 0.99 | 0.01 | -1.07 |
| Inst. exp. /pupil | 1,864.87 | 168.77 | 1.30E-04 | 1.00 | 0.00 | 0.64 |
| Adm. exp./pupil | 198.58 | 31.20 | 2.41E-04 | 1.00 | 0.00 | 0.21 |
| Fraction nonwhite pupils in district | 0.53 | 0.25 | -8.57E-02 | 0.92 | 0.32 | -0.25 |
| No. pupils in school | 949.56 | 392.27 | -2.00E-04 | 1.00 | 0.00 | -1.50 |
| No. pupils in school cubed | 1.43E+09 | 4.29E+09 | 1.13E-11 | 1.00 | 0.00 | 1.73 |
| Pct. students Black | 7.37 | 9.42 | 1.82E-02 | 1.02 | 0.00 | 4.16 |
| Pct. students Hispanic | 32.79 | 24.43 | 5.80E-03 | 1.01 | 0.00 | 1.45 |
| Pct. students Asian | 11.79 | 13.09 | 1.69E-03 | 1.00 | 0.00 | 0.38 |
| Pct. students Am Indian | 0.91 | 2.46 | 1.52E-02 | 1.02 | 0.01 | 1.91 |
| Pct. students Free lunch eligible | 40.81 | 24.68 | -1.34E-03 | 1.00 | 0.00 | -0.59 |
| Class size | 34.23 | 23.75 | -1.49E-03 | 1.00 | 0.00 | -1.34 |
| Rural | 0.05 | 0.22 | -1.88E-01 | 0.83 | 0.11 | -1.44 |
| Urban | 0.29 | 0.45 | -2.82E-01 | 0.75 | 0.05 | -4.02 |
| Teacher credentialed | 0.98 | 0.14 | -3.96E-01 | 0.67 | 0.08 | -3.15 |
| Female | 0.60 | 0.49 | 1.40E-01 | 1.15 | 0.06 | 2.70 |
| No prior experience | 0.07 | 0.25 | 3.92E-01 | 1.48 | 0.13 | 4.52 |
| 1 - 3 yrs experience | 0.19 | 0.39 | 2.09E-01 | 1.23 | 0.10 | 2.61 |
| Total experience | 12.73 | 9.21 | -4.50E-02 | 0.96 | 0.00 | -8.78 |
| Age | 41.15 | 8.81 | 6.66E-01 | 1.95 | 0.36 | 3.57 |
| Age squared | 1,771.01 | 706.40 | -1.94E-02 | 0.98 | 0.00 | -3.95 |
| Age cubed | 79,070.62 | 44,145.27 | 1.76E-04 | 1.00 | 0.00 | 4.22 |
| Ed, BA or less | 0.11 | 0.31 | 2.67E-01 | 1.31 | 0.10 | 3.56 |
| Ed, MA or more | 0.31 | 0.46 | 3.97E-01 | 1.49 | 0.09 | 6.57 |
| Asian | 0.04 | 0.19 | 1.41E-01 | 1.15 | 0.14 | 1.19 |
| Black | 0.04 | 0.19 | 2.42E-01 | 1.27 | 0.17 | 1.79 |
| Hispanic | 0.07 | 0.26 | -7.05E-02 | 0.93 | 0.09 | -0.75 |
| Am. Indian | 0.01 | 0.09 | 2.30E-01 | 1.26 | 0.30 | 0.98 |
| Race/ethnicity unknown | 0.00 | 0.04 | -8.57E-01 | 0.42 | 0.35 | -1.04 |
| Number of obs | | | 20,020 | | | |
| Chi2 | | | 888 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.2e

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Leave Their District:
Grade 9-12 Math and Science Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|-----------|-----------|---------------|------------|---------|
| Dependent Variable/Constant | 0.11 | 0.31 | -12.05 | | 3.66 | -3.30 |
| Population density | 1,412.95 | 2,363.71 | -1.55E-05 | 1.00 | 0.00 | -0.38 |
| Unemployment rate | 8.23 | 3.67 | 4.35E-02 | 1.04 | 0.02 | 2.57 |
| Ave. wage, all industries | 28,957.39 | 5,642.27 | 4.54E-05 | 1.00 | 0.00 | 2.79 |
| Ave. wage, federal employees | 39,253.30 | 5,413.94 | -2.85E-06 | 1.00 | 0.00 | -0.24 |
| Per capita income | 23,601.21 | 5,381.13 | 1.69E-05 | 1.00 | 0.00 | 1.19 |
| No. Pupils in district | 18,397.76 | 16,070.71 | -1.96E-05 | 1.00 | 0.00 | -1.71 |
| No. pupils in district cubed | 2.74E+13 | 8.01E+13 | 1.57E-15 | 1.00 | 0.00 | 1.27 |
| No. schools in district | 21.95 | 22.14 | 4.60E-03 | 1.00 | 0.01 | 0.53 |
| No. schools in district cubed | 66,573.85 | 2.19E+05 | -6.04E-08 | 1.00 | 0.00 | -0.08 |
| Maximum teachers' salary | 51,417.99 | 4,091.09 | -1.06E-05 | 1.00 | 0.00 | -0.79 |
| Rate of enrollment growth | 1.43 | 2.20 | 1.33E-02 | 1.01 | 0.02 | 0.82 |
| Inst. exp. /pupil | 1,916.98 | 201.22 | 1.18E-04 | 1.00 | 0.00 | 0.40 |
| Adm. exp./pupil | 202.01 | 38.70 | -6.37E-04 | 1.00 | 0.00 | -0.54 |
| Fraction nonwhite pupils in district | 0.52 | 0.24 | 4.69E-01 | 1.60 | 0.72 | 1.04 |
| No. pupils in school | 1,872.76 | 820.26 | 1.05E-05 | 1.00 | 0.00 | 0.11 |
| No. pupils in school cubed | 1.05E+10 | 1.41E+10 | 1.60E-12 | 1.00 | 0.00 | 0.32 |
| Pct. students Black | 7.20 | 9.30 | 8.89E-03 | 1.01 | 0.01 | 1.68 |
| Pct. students Hispanic | 30.34 | 22.91 | -4.25E-03 | 1.00 | 0.00 | -0.90 |
| Pct. students Asian | 12.99 | 13.95 | -9.93E-03 | 0.99 | 0.00 | -1.97 |
| Pct. students Am Indian | 1.02 | 2.31 | -2.54E-02 | 0.97 | 0.02 | -1.07 |
| Pct. students Free lunch eligible | 24.65 | 17.30 | 9.62E-03 | 1.01 | 0.00 | 3.23 |
| Class size | 31.62 | 13.22 | -1.69E-04 | 1.00 | 0.00 | -0.06 |
| Rural | 0.06 | 0.23 | 1.02E-01 | 1.11 | 0.22 | 0.51 |
| Urban | 0.28 | 0.45 | -2.72E-01 | 0.76 | 0.07 | -2.77 |
| Teacher credentialed | 0.98 | 0.15 | -5.00E-01 | 0.61 | 0.11 | -2.81 |
| Female | 0.37 | 0.48 | 1.82E-01 | 1.20 | 0.09 | 2.45 |
| No prior experience | 0.07 | 0.25 | 5.08E-01 | 1.66 | 0.22 | 3.91 |
| 1 - 3 yrs experience | 0.18 | 0.38 | 2.96E-01 | 1.34 | 0.17 | 2.34 |
| Total experience | 13.38 | 9.35 | -6.52E-02 | 0.94 | 0.01 | -8.68 |
| Age | 41.06 | 8.87 | 8.34E-01 | 2.30 | 0.67 | 2.88 |
| Age squared | 1,764.66 | 712.44 | -2.34E-02 | 0.98 | 0.01 | -3.09 |
| Age cubed | 78,745.33 | 44,611.63 | 2.10E-04 | 1.00 | 0.00 | 3.29 |
| Ed, BA or less | 0.10 | 0.30 | -1.02E-02 | 0.99 | 0.11 | -0.09 |
| Ed, MA or more | 0.39 | 0.49 | 1.77E-01 | 1.19 | 0.11 | 1.98 |
| Asian | 0.05 | 0.23 | 1.18E-01 | 1.13 | 0.18 | 0.76 |
| Black | 0.03 | 0.17 | 3.73E-01 | 1.45 | 0.30 | 1.83 |
| Hispanic | 0.06 | 0.24 | -1.76E-01 | 0.84 | 0.12 | -1.21 |
| Am. Indian | 0.01 | 0.10 | 7.71E-01 | 2.16 | 0.70 | 2.37 |
| Race/ethnicity unknown | 0.00 | 0.05 | 5.87E-01 | 1.80 | 0.97 | 1.09 |
| Number of obs | | | 8,455 | | | |
| Chi2 | | | 529 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.2f

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Leave Their District:
Grade 9-12 Other Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|--------------------------------------|-----------|-----------|-----------|---------------|------------|---------|
| Dependent Variable/Constant | 0.09 | 0.29 | -11.93 | | 2.37 | -5.03 |
| Population density | 1,338.23 | 2,297.67 | -4.27E-05 | 1.00 | 0.00 | -1.40 |
| Unemployment rate | 8.40 | 3.78 | 1.11E-02 | 1.01 | 0.01 | 0.87 |
| Ave. wage, all industries | 28,666.56 | 5,657.01 | 1.10E-05 | 1.00 | 0.00 | 0.86 |
| Ave. wage, federal employees | 38,986.32 | 5,507.35 | 6.35E-06 | 1.00 | 0.00 | 0.77 |
| Per capita income | 23,388.43 | 5,390.46 | 4.70E-06 | 1.00 | 0.00 | 0.40 |
| No. Pupils in district | 18,042.04 | 16,021.38 | -2.20E-05 | 1.00 | 0.00 | -2.80 |
| No. pupils in district cubed | 2.67E+13 | 7.96E+13 | 1.71E-15 | 1.00 | 0.00 | 2.35 |
| No. schools in district | 21.60 | 21.97 | 6.11E-03 | 1.01 | 0.01 | 0.99 |
| No. schools in district cubed | 64,581.83 | 2.15E+05 | 2.39E-07 | 1.00 | 0.00 | 0.45 |
| Maximum teachers' salary | 51,250.73 | 4,090.88 | 5.93E-06 | 1.00 | 0.00 | 0.67 |
| Rate of enrollment growth | 1.45 | 2.23 | 6.27E-03 | 1.01 | 0.01 | 0.52 |
| Inst. exp. /pupil | 1,915.71 | 202.47 | 1.75E-05 | 1.00 | 0.00 | 0.09 |
| Adm. exp./pupil | 202.16 | 39.43 | 2.16E-04 | 1.00 | 0.00 | 0.23 |
| Fraction nonwhite pupils in district | 0.52 | 0.24 | 4.17E-02 | 1.04 | 0.30 | 0.14 |
| No. pupils in school | 1,844.11 | 827.68 | -1.02E-04 | 1.00 | 0.00 | -1.64 |
| No. pupils in school cubed | 1.02E+10 | 1.37E+10 | 1.90E-12 | 1.00 | 0.00 | 0.64 |
| Pct. students Black | 6.99 | 9.20 | 1.25E-02 | 1.01 | 0.00 | 3.41 |
| Pct. students Hispanic | 30.71 | 22.99 | 4.23E-04 | 1.00 | 0.00 | 0.14 |
| Pct. students Asian | 12.41 | 13.52 | -3.93E-03 | 1.00 | 0.00 | -1.13 |
| Pct. students Am Indian | 1.06 | 2.36 | 3.56E-03 | 1.00 | 0.01 | 0.28 |
| Pct. students Free lunch eligible | 25.12 | 17.51 | 4.55E-03 | 1.00 | 0.00 | 2.05 |
| Class size | 32.13 | 17.78 | 1.33E-04 | 1.00 | 0.00 | 0.08 |
| Rural | 0.06 | 0.24 | -7.03E-03 | 0.99 | 0.15 | -0.05 |
| Urban | 0.28 | 0.45 | 6.76E-02 | 1.07 | 0.07 | 0.99 |
| Teacher credentialed | 0.99 | 0.12 | -4.66E-01 | 0.63 | 0.10 | -2.90 |
| Female | 0.50 | 0.50 | 1.98E-01 | 1.22 | 0.06 | 3.80 |
| No prior experience | 0.06 | 0.23 | 4.10E-01 | 1.51 | 0.13 | 4.59 |
| 1 - 3 yrs experience | 0.15 | 0.36 | 1.84E-01 | 1.20 | 0.10 | 2.18 |
| Total experience | 14.99 | 9.54 | -5.13E-02 | 0.95 | 0.00 | -10.78 |
| Age | 42.56 | 8.76 | 8.46E-01 | 2.33 | 0.42 | 4.65 |
| Age squared | 1,888.40 | 708.58 | -2.43E-02 | 0.98 | 0.00 | -5.16 |
| Age cubed | 86,550.48 | 44,717.04 | 2.23E-04 | 1.00 | 0.00 | 5.63 |
| Ed, BA or less | 0.09 | 0.29 | 3.37E-01 | 1.40 | 0.11 | 4.33 |
| Ed, MA or more | 0.39 | 0.49 | 3.03E-01 | 1.35 | 0.08 | 5.23 |
| Asian | 0.03 | 0.17 | 1.59E-01 | 1.17 | 0.16 | 1.16 |
| Black | 0.03 | 0.17 | -2.55E-02 | 0.97 | 0.16 | -0.15 |
| Hispanic | 0.09 | 0.29 | 1.65E-01 | 1.18 | 0.09 | 2.09 |
| Am. Indian | 0.01 | 0.10 | 1.18E-01 | 1.12 | 0.27 | 0.49 |
| Race/ethnicity unknown | 0.00 | 0.04 | 7.51E-01 | 2.12 | 0.91 | 1.75 |
| Number of obs | | | 21,593 | | | |
| Chi2 | | | 858 | | | |
| Prob > chi2 | | | 0.000 | | | |

THE SUPPLY OF TEACHERS FROM OUTSIDE THE DISTRICT

As noted earlier, districts draw both credentialed teachers and teachers who (generally) have BAs but who are not credentialed. We assume districts would generally prefer to employ a credentialed teacher and resort to employing underqualified teachers only when they cannot obtain sufficient credentialed teachers to meet their staffing targets. We also assume that districts would generally prefer to meet staffing targets, even if they must hire underqualified teachers to do so, rather than go short of teaching staff and incur vacancies.

We model the supply of teachers from outside the district in two parts: first, we examine the fraction of newly hired teachers who are credentialed. Our concern here is the factors that affect the degree to which the district is forced to hire underqualified teachers. In particular, we seek to identify the extent to which the characteristics of a district's student body affect its ability to attract qualified teachers, controlling for other factors. Second, we examine the degree to which the district is able to recruit sufficient teachers, credentialed or not, to meet its hiring goals. Our concern here is the factors that affect the degree to which the district is able to recruit a sufficient number of teachers to meet its hiring goals, regardless of whether or not those newly hired teachers are credentialed. In particular, we seek to identify the extent to which the characteristics of a district's student body affect its ability to attract teachers, controlling for other factors.

Our data for the sample of districts included in this study include all teachers who were employed in a sample district in the 1994, 1995, and 1996 school years. Because each teacher in the sample was assigned a unique identification number, we can identify those teachers who were employed in each district in 1995 and in 1996 who had not been employed in that district the prior year. We used these data to explore the factors that

affected the relative attractiveness of a district to teachers who were not employed in that district.

The Supply of Credentialed Teachers from Outside the District

We assume a teacher's decision to enter the district is influenced by the characteristics of the district and the county in which the district is located. The district characteristics we consider include its location (urban, suburban, or rural), size (number of schools and number of students), the racial/ethnic distribution of its students, the fraction of its students eligible for free or reduced cost lunch, and the rate of growth in enrollments from the previous year. We also include the characteristics of the county in which the district is located (population density, the unemployment rate, average wage in all industries, average wage in federal employment). The salary the district offers a teacher presumably also influences his or her decision to enter the district. We do not have data on individual teacher's salaries; we enter the average salary in a teacher's district as a rough measure of the teacher's salary.

Preliminary analyses suggested that the effects of the variables measuring district size (the number of schools and of students in the district) were nonlinear. To control for nonlinearities, we included those independent variables both linearly and cubed.

We used data for 1995 and 1996 to estimate the model. Table 4.3 presents the empirical results for a model of the district's ability to attract qualified teachers in 1995. The dependent variable is the fraction of newly hired teachers in a district who are credentialed. Table 4.4 presents the corresponding results for a model of the district's ability to attract qualified teachers in 1996.

The results for 1995 are mixed. For all teachers, combined, and for K-3 teachers, the percent of the students in a district who are either Black or Hispanic has a negative effect

on the district's ability to recruit credentialed teachers. The effects of percent Black and of percent Hispanic are also negative, but not significant, for teachers in grades 4-6 and 6-8 and for both math/science and other teachers in grades 9-12, both math and science. The effect of percent Hispanic is also negative, but not significant, for teachers in grades 4-6 and 6-8 and for both math/science and other teachers in grades 9-12, both math and science.

The results for 1996 are similarly mixed. The coefficients for percent Black and percent Hispanic are always negative, but often not significant.

None of the other measures of a district's characteristics or of the characteristics of the county in which the district was located had a significant effect on the fraction of newly hired teachers in a district who were credentialed.

Table 4.3a

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
All Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.90 | 0.30 | 4.48 | | 1.32 | 3.40 |
| Population density | 1,395.72 | 2,135.83 | -1.67E-05 | 1.00 | 0.00 | -0.17 |
| Unemployment rate | 8.25 | 3.53 | -1.09E-02 | 0.99 | 0.03 | -0.37 |
| Ave. wage | 29,056.68 | 5,356.79 | -4.80E-05 | 1.00 | 0.00 | -1.32 |
| Federal wage | 39,350.45 | 5,265.60 | -6.41E-06 | 1.00 | 0.00 | -0.34 |
| Per capita income | 23,535.30 | 5,254.72 | 1.52E-05 | 1.00 | 0.00 | 0.39 |
| No. Pupils in district | 18,108.30 | 17,663.54 | -8.80E-06 | 1.00 | 0.00 | -0.29 |
| No. pupils in district cubed | 3.30E+13 | 9.93E+13 | -6.52E-15 | 1.00 | 0.00 | -2.01 |
| No. schools in district | 22.69 | 21.92 | 1.70E-02 | 1.02 | 0.03 | 0.65 |
| No. schools in district cubed | 65,674.52 | 2.05E+05 | 3.23E-06 | 1.00 | 0.00 | 1.26 |
| Rate of enrollment growth | 1.40 | 2.30 | 3.01E-02 | 1.03 | 0.03 | 0.90 |
| Ave. teachers' salary | 26,016.28 | 2,129.36 | -3.71E-06 | 1.00 | 0.00 | -0.11 |
| Inst. exp. /pupil | 1,863.02 | 189.50 | -1.19E-04 | 1.00 | 0.00 | -0.24 |
| Adm. exp./pupil | 199.85 | 36.13 | 3.13E-03 | 1.00 | 0.00 | 1.27 |
| Urban | 0.22 | 0.41 | 7.29E-02 | 1.08 | 0.25 | 0.31 |
| Rural | 0.04 | 0.20 | -2.61E-01 | 0.77 | 0.27 | -0.76 |
| Fraction students Black | 0.08 | 0.10 | -3.17E+00 | 0.04 | 0.04 | -3.13 |
| Fraction students Hispanic | 0.36 | 0.23 | -1.45E+00 | 0.23 | 0.11 | -3.22 |
| Fraction students Asian | 0.11 | 0.11 | 6.93E-01 | 2.00 | 1.94 | 0.72 |
| Fraction students Am Indian | 0.01 | 0.02 | -2.05E+00 | 0.13 | 0.29 | -0.91 |
| Fraction students Free lunch eligible | 0.42 | 0.22 | -3.15E-01 | 0.73 | 0.38 | -0.61 |
| Female | 0.71 | 0.45 | 5.85E-01 | 1.79 | 0.13 | 8.12 |
| No prior experience | 0.47 | 0.50 | -2.90E-01 | 0.75 | 0.07 | -3.11 |
| 1 - 3 yrs experience | 0.63 | 0.48 | -1.49E-01 | 0.86 | 0.14 | -0.93 |
| Total experience | 5.40 | 7.38 | 1.05E-01 | 1.11 | 0.03 | 4.12 |
| Total experience cubed | 1,942.45 | 7,260.32 | -3.12E-05 | 1.00 | 0.00 | -1.52 |
| Age | 35.07 | 9.93 | 9.54E-03 | 1.01 | 0.02 | 0.61 |
| Age cubed | 54,240.03 | 49,044.11 | -1.32E-06 | 1.00 | 0.00 | -0.41 |
| Education, BA or less | 0.26 | 0.44 | -1.44E+00 | 0.24 | 0.02 | -15.49 |
| Education, MA or more | 0.20 | 0.40 | -7.54E-01 | 0.47 | 0.06 | -5.98 |
| Asian | 0.05 | 0.23 | -3.33E-01 | 0.72 | 0.09 | -2.58 |
| Black | 0.04 | 0.20 | -7.19E-01 | 0.49 | 0.08 | -4.39 |
| Hispanic | 0.14 | 0.35 | -9.49E-01 | 0.39 | 0.04 | -8.53 |
| Am. Indian | 0.01 | 0.09 | -4.46E-01 | 0.64 | 0.25 | -1.16 |
| Race/ethnicity unknown | 0.01 | 0.08 | -6.34E-01 | 0.53 | 0.17 | -2.03 |
| Chi2 | | | 13,913 | | | |
| Prob > chi2 | | | 1,287 | | | |
| | | | 0.000 | | | |

Table 4.3b

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
K-3 Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.90 | 0.30 | 2.30 | | 1.20 | 1.92 |
| Population density (000) | 1,467.92 | 2,099.24 | -1.54E-04 | 1.00 | 0.00 | -1.12 |
| Unemployment rate | 8.08 | 3.27 | 1.08E-02 | 1.01 | 0.05 | 0.20 |
| Ave. wage | 29,145.73 | 5,066.11 | 1.79E-05 | 1.00 | 0.00 | 0.31 |
| Federal wage | 39,543.24 | 5,064.80 | -1.19E-06 | 1.00 | 0.00 | -0.04 |
| Per capita income | 23,502.09 | 5,005.91 | -2.46E-05 | 1.00 | 0.00 | -0.44 |
| No. Pupils in district | 18,922.54 | 18,167.55 | -7.32E-07 | 1.00 | 0.00 | 0.31 |
| No. pupils in district cubed | 3.60E+13 | 1.04E+14 | -1.06E-14 | 1.00 | 0.00 | -2.48 |
| No. schools in district | 24.07 | 21.84 | 1.04E-03 | 1.00 | 0.04 | 0.03 |
| No. schools in district cubed | 68,127.92 | 2.02E+05 | 3.92E-06 | 1.00 | 0.00 | 1.29 |
| Rate of enrollment growth | 1.33 | 2.17 | 2.90E-02 | 1.03 | 0.07 | 0.46 |
| Ave. teachers' salary | 26,132.66 | 2,131.39 | 4.32E-05 | 1.00 | 0.00 | 0.81 |
| Inst. exp. /pupil | 1,835.38 | 164.15 | 8.82E-05 | 1.00 | 0.00 | 0.13 |
| Adm. exp./pupil | 196.03 | 33.50 | 6.54E-03 | 1.01 | 0.00 | 1.80 |
| Urban | 0.22 | 0.42 | 4.45E-01 | 1.56 | 0.54 | 1.29 |
| Rural | 0.03 | 0.17 | 2.92E-01 | 1.34 | 0.63 | 0.63 |
| Fraction students Black | 0.09 | 0.10 | -4.24E+00 | 0.01 | 0.02 | -3.30 |
| Fraction students Hispanic | 0.38 | 0.24 | -1.86E+00 | 0.16 | 0.12 | -2.41 |
| Fraction students Asian | 0.10 | 0.10 | 3.50E+00 | 33.25 | 62.87 | 1.85 |
| Fraction students Am Indian | 0.01 | 0.02 | -2.87E+00 | 0.06 | 0.18 | -0.91 |
| Fraction students Free lunch eligible | 0.46 | 0.22 | -4.17E-01 | 0.66 | 0.57 | -0.48 |
| Female | 0.90 | 0.30 | 5.82E-01 | 1.79 | 0.27 | 3.85 |
| No prior experience | 0.49 | 0.50 | -2.90E-01 | 0.75 | 0.14 | -1.61 |
| 1 - 3 yrs experience | 0.64 | 0.48 | -4.57E-01 | 0.63 | 0.19 | -1.49 |
| Total experience | 5.09 | 7.08 | 2.91E-02 | 1.03 | 0.05 | 0.62 |
| Total experience cubed | 1,753.64 | 7,195.48 | 1.18E-05 | 1.00 | 0.00 | 0.32 |
| Age | 34.11 | 9.63 | -1.38E-02 | 0.99 | 0.03 | -0.50 |
| Age cubed | 49,924.64 | 46,015.04 | 6.04E-06 | 1.00 | 0.00 | 0.93 |
| Education, BA or less | 0.28 | 0.45 | -1.42E+00 | 0.24 | 0.03 | -10.21 |
| Education, MA or more | 0.15 | 0.36 | -5.16E-01 | 0.60 | 0.14 | -2.16 |
| Asian | 0.06 | 0.23 | -4.49E-01 | 0.64 | 0.16 | -1.83 |
| Black | 0.04 | 0.19 | -6.42E-01 | 0.53 | 0.22 | -1.51 |
| Hispanic | 0.20 | 0.40 | -1.39E+00 | 0.25 | 0.04 | -7.93 |
| Am. Indian | 0.01 | 0.08 | -2.64E-01 | 0.77 | 0.50 | -0.40 |
| Race/ethnicity unknown | 0.01 | 0.07 | 2.30E+00 | 0.77 | 0.50 | -0.40 |
| Number of ob | | | 4,832 | | | |
| Chi2 | | | 1,030 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.3c

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
Grades 4-6 Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.91 | 0.28 | 4.41 | | 1.69 | 2.61 |
| Population density | 1,442.44 | 2,203.62 | -4.57E-05 | 1.00 | 0.00 | -0.26 |
| Unemployment rate | 8.46 | 3.63 | -2.07E-02 | 0.98 | 0.06 | -0.35 |
| Ave. wage | 28,964.84 | 5,242.13 | -7.93E-05 | 1.00 | 0.00 | -1.26 |
| Federal wage | 39,113.01 | 5,455.03 | -3.42E-06 | 1.00 | 0.00 | -0.09 |
| Per capita income | 23,266.19 | 5,084.87 | 1.75E-05 | 1.00 | 0.00 | 0.26 |
| No. Pupils in district | 17,985.75 | 17,796.81 | -1.59E-05 | 1.00 | 0.00 | -0.22 |
| No. pupils in district cubed | 3.30E+13 | 9.89E+13 | -7.08E-15 | 1.00 | 0.00 | -1.35 |
| No. schools in district | 23.35 | 22.21 | 3.25E-02 | 1.03 | 0.06 | 0.57 |
| No. schools in district cubed | 68,553.92 | 2.10E+05 | 1.55E-06 | 1.00 | 0.00 | 0.49 |
| Rate of enrollment growth | 1.29 | 2.21 | 2.65E-02 | 1.03 | 0.07 | 0.40 |
| Ave. teachers' salary | 26,042.26 | 2,071.38 | 6.80E-05 | 1.00 | 0.00 | 1.08 |
| Inst. exp. /pupil | 1,830.09 | 165.22 | -5.38E-04 | 1.00 | 0.00 | -0.54 |
| Adm. exp./pupil | 197.05 | 33.01 | 8.45E-03 | 1.01 | 0.00 | 2.04 |
| Urban | 0.22 | 0.41 | 4.63E-01 | 1.59 | 0.75 | 0.98 |
| Rural | 0.04 | 0.20 | 6.32E-02 | 1.07 | 0.83 | 0.08 |
| Fraction students Black | 0.09 | 0.10 | -2.37E+00 | 0.09 | 0.15 | -1.47 |
| Fraction students Hispanic | 0.38 | 0.24 | -1.72E+00 | 0.18 | 0.17 | -1.83 |
| Fraction students Asian | 0.10 | 0.11 | 1.57E+00 | 4.81 | 8.73 | 0.87 |
| Fraction students Am Indian | 0.01 | 0.03 | -3.24E+00 | 0.04 | 0.10 | -1.27 |
| Fraction students Free lunch eligible | 0.47 | 0.22 | -1.30E+00 | 0.27 | 0.30 | -1.20 |
| Female | 0.78 | 0.41 | 6.58E-01 | 1.93 | 0.39 | 3.23 |
| No prior experience | 0.50 | 0.50 | -8.26E-01 | 0.44 | 0.13 | -2.77 |
| 1 - 3 yrs experience | 0.65 | 0.48 | 3.09E-01 | 1.36 | 0.63 | 0.67 |
| Total experience | 5.21 | 7.36 | 1.32E-01 | 1.14 | 0.07 | 2.20 |
| Total experience cubed | 1,883.74 | 6,469.61 | -8.14E-05 | 1.00 | 0.00 | -1.93 |
| Age | 34.41 | 9.74 | -2.12E-02 | 0.98 | 0.04 | -0.51 |
| Age cubed | 51,271.89 | 47,413.05 | 5.77E-06 | 1.00 | 0.00 | 0.67 |
| Education, BA or less | 0.25 | 0.43 | -1.21E+00 | 0.30 | 0.06 | -6.49 |
| Education, MA or more | 0.16 | 0.37 | -2.92E-02 | 0.97 | 0.37 | -0.08 |
| Asian | 0.04 | 0.20 | -4.61E-01 | 0.63 | 0.22 | -1.30 |
| Black | 0.05 | 0.22 | -1.35E+00 | 0.26 | 0.10 | -3.48 |
| Hispanic | 0.15 | 0.36 | -1.25E+00 | 0.29 | 0.07 | -5.16 |
| Am. Indian | 0.01 | 0.09 | -1.27E+00 | 0.28 | 0.26 | -1.36 |
| Race/ethnicity unknown | 0.01 | 0.08 | 1.07E-01 | 1.11 | 1.42 | 0.08 |
| Number of obs. | | | 2,185 | | | |
| Chi2 | | | 460 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.3d

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
Grades 6-8 Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.90 | 0.30 | 8.44 | | | |
| Population density | 1,323.35 | 2,109.30 | 2.74E-05 | 1.00 | 0.00 | 0.19 |
| Unemployment rate | 8.27 | 3.52 | -5.82E-02 | 0.94 | 0.04 | -1.25 |
| Ave. wage | 28,893.12 | 5,410.25 | -5.44E-05 | 1.00 | 0.00 | -1.03 |
| Federal wage | 39,252.12 | 5,151.00 | -2.58E-05 | 1.00 | 0.00 | -0.81 |
| Per capita income | 23,583.82 | 5,396.09 | 1.42E-05 | 1.00 | 0.00 | 0.31 |
| No. Pupils in district | 17,975.74 | 18,456.61 | 4.31E-05 | 1.00 | 0.00 | 1.03 |
| No. pupils in district cubed | 3.60E+13 | 1.08E+14 | -8.42E-15 | 1.00 | 0.00 | -1.89 |
| No. schools in district | 22.70 | 22.10 | -4.03E-02 | 0.96 | 0.03 | -1.15 |
| No. schools in district cubed | 66,799.13 | 2.06E+05 | 6.83E-06 | 1.00 | 0.00 | 1.74 |
| Rate of enrollment growth | 1.36 | 2.37 | 9.14E-02 | 1.10 | 0.06 | 1.69 |
| Ave. teachers' salary | 25,945.43 | 2,062.21 | -4.45E-05 | 1.00 | 0.00 | -0.86 |
| Inst. exp. /pupil | 1,856.87 | 177.61 | -6.60E-04 | 1.00 | 0.00 | -1.04 |
| Adm. exp./pupil | 200.27 | 31.23 | 3.23E-03 | 1.00 | 0.00 | 0.87 |
| Urban | 0.23 | 0.42 | -1.19E-01 | 0.89 | 0.25 | -0.43 |
| Rural | 0.04 | 0.20 | 1.34E+00 | 3.80 | 2.93 | 1.73 |
| Fraction students Black | 0.08 | 0.09 | -2.28E+00 | 0.10 | 0.14 | -1.62 |
| Fraction students Hispanic | 0.34 | 0.23 | -1.36E+00 | 0.26 | 0.19 | -1.87 |
| Fraction students Asian | 0.11 | 0.11 | 1.49E+00 | 4.43 | 5.43 | 1.21 |
| Fraction students Am Indian | 0.01 | 0.02 | -2.19E+00 | 0.11 | 0.36 | -0.68 |
| Fraction students Free lunch eligible | 0.42 | 0.21 | -2.32E-01 | 0.79 | 0.64 | -0.29 |
| Female | 0.61 | 0.49 | 6.81E-01 | 1.98 | 0.26 | 5.08 |
| No prior experience | 0.46 | 0.50 | -4.39E-01 | 0.64 | 0.16 | -1.77 |
| 1 – 3 yrs experience | 0.64 | 0.48 | -1.03E+00 | 0.36 | 0.16 | -2.30 |
| Total experience | 5.19 | 7.15 | -6.48E-03 | 0.99 | 0.06 | -0.10 |
| Total experience cubed | 1,802.55 | 7,477.07 | 1.28E-04 | 1.00 | 0.00 | 1.44 |
| Age | 35.31 | 9.67 | 2.84E-02 | 1.03 | 0.03 | 0.85 |
| Age cubed | 54,548.35 | 47,139.59 | -7.64E-06 | 1.00 | 0.00 | -1.06 |
| Education, BA or less | 0.26 | 0.44 | -1.74E+00 | 0.17 | 0.03 | -9.09 |
| Education, MA or more | 0.21 | 0.41 | -1.01E+00 | 0.36 | 0.09 | -3.96 |
| Asian | 0.05 | 0.22 | -2.31E-01 | 0.79 | 0.24 | -0.77 |
| Black | 0.04 | 0.21 | -7.51E-01 | 0.47 | 0.16 | -2.23 |
| Hispanic | 0.10 | 0.30 | -3.45E-01 | 0.71 | 0.15 | -1.59 |
| Am. Indian | 0.01 | 0.10 | -9.12E-01 | 0.40 | 0.23 | -1.60 |
| Race/ethnicity unknown | 0.00 | 0.06 | -1.36E+00 | 0.26 | 0.21 | -1.66 |
| Chi2 | | | 2,846 | | | |
| Prob > chi2 | | | 338 | | | |
| | | | 0.000 | | | |

Table 4.3d

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
Grades 6-8 Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.90 | 0.30 | 6.78 | | 2.23 | 3.04 |
| Population density | 1,323.35 | 2,109.30 | 2.74E-05 | 1.00 | 0.00 | 0.19 |
| Unemployment rate | 8.27 | 3.52 | -5.82E-02 | 0.94 | 0.04 | -1.25 |
| Ave. wage | 28,893.12 | 5,410.25 | -5.44E-05 | 1.00 | 0.00 | -1.03 |
| Federal wage | 39,252.12 | 5,151.00 | -2.58E-05 | 1.00 | 0.00 | -0.81 |
| Per capita income | 23,583.82 | 5,396.09 | 1.42E-05 | 1.00 | 0.00 | 0.31 |
| No. Pupils in district | 17,975.74 | 18,456.61 | 4.31E-05 | 1.00 | 0.00 | 1.03 |
| No. pupils in district cubed | 3.60E+13 | 1.08E+14 | -8.42E-15 | 1.00 | 0.00 | -1.89 |
| No. schools in district | 22.70 | 22.10 | -4.03E-02 | 0.96 | 0.03 | -1.15 |
| No. schools in district cubed | 66,799.13 | 2.06E+05 | 6.83E-06 | 1.00 | 0.00 | 1.74 |
| Rate of enrollment growth | 1.36 | 2.37 | 9.14E-02 | 1.10 | 0.06 | 1.69 |
| Ave. teachers' salary | 25,945.43 | 2,062.21 | -4.45E-05 | 1.00 | 0.00 | -0.86 |
| Inst. exp. /pupil | 1,856.87 | 177.61 | -6.60E-04 | 1.00 | 0.00 | -1.04 |
| Adm. exp./pupil | 200.27 | 31.23 | 3.23E-03 | 1.00 | 0.00 | 0.87 |
| Urban | 0.23 | 0.42 | -1.19E-01 | 0.89 | 0.25 | -0.43 |
| Rural | 0.04 | 0.20 | 1.34E+00 | 3.80 | 2.93 | 1.73 |
| Fraction students Black | 0.08 | 0.09 | -2.28E+00 | 0.10 | 0.14 | -1.62 |
| Fraction students Hispanic | 0.34 | 0.23 | -1.36E+00 | 0.26 | 0.19 | -1.87 |
| Fraction students Asian | 0.11 | 0.11 | 1.49E+00 | 4.43 | 5.43 | 1.21 |
| Fraction students Am Indian | 0.01 | 0.02 | -2.19E+00 | 0.11 | 0.36 | -0.68 |
| Fraction students Free lunch eligible | 0.42 | 0.21 | -2.32E-01 | 0.79 | 0.64 | -0.29 |
| Female | 0.61 | 0.49 | 6.81E-01 | 1.98 | 0.26 | 5.08 |
| No prior experience | 0.46 | 0.50 | -4.39E-01 | 0.64 | 0.16 | -1.77 |
| 1 - 3 yrs experience | 0.64 | 0.48 | -1.03E+00 | 0.36 | 0.16 | -2.30 |
| Total experience | 5.19 | 7.15 | -6.48E-03 | 0.99 | 0.06 | -0.10 |
| Total experience cubed | 1,802.55 | 7,477.07 | 1.28E-04 | 1.00 | 0.00 | 1.44 |
| Age | 35.31 | 9.67 | 2.84E-02 | 1.03 | 0.03 | 0.85 |
| Age cubed | 54,548.35 | 47,139.59 | -7.64E-06 | 1.00 | 0.00 | -1.06 |
| Education, BA or less | 0.26 | 0.44 | -1.74E+00 | 0.17 | 0.03 | -9.09 |
| Education, MA or more | 0.21 | 0.41 | -1.01E+00 | 0.36 | 0.09 | -3.96 |
| Asian | 0.05 | 0.22 | -2.31E-01 | 0.79 | 0.24 | -0.77 |
| Black | 0.04 | 0.21 | -7.51E-01 | 0.47 | 0.16 | -2.23 |
| Hispanic | 0.10 | 0.30 | -3.45E-01 | 0.71 | 0.15 | -1.59 |
| Am. Indian | 0.01 | 0.10 | -9.12E-01 | 0.40 | 0.23 | -1.60 |
| Race/ethnicity unknown | 0.00 | 0.06 | -1.36E+00 | 0.26 | 0.21 | -1.66 |
| Number of ob | | | 2,846 | | | |
| Chi2 | | | 338 | | | |
| Prob > chi2 | | | 0.000 | | | |

57
Table 4.3e

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
Grades 9-12 Math Science Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.87 | 0.34 | 4.74 | | 2.25 | 2.10 |
| Population density | 1,372.93 | 1,970.82 | 1.00E-04 | 1.00 | 0.00 | 0.60 |
| Unemployment rate | 8.23 | 3.86 | 3.14E-02 | 1.03 | 0.06 | 0.54 |
| Ave. wage | 29,531.70 | 5,654.05 | -3.92E-05 | 1.00 | 0.00 | -0.60 |
| Federal wage | 39,816.52 | 5,230.76 | -1.48E-05 | 1.00 | 0.00 | -0.38 |
| Per capita income | 23,907.16 | 5,443.13 | 1.77E-05 | 1.00 | 0.00 | 0.31 |
| No. Pupils in district | 17,260.75 | 16,287.83 | -2.24E-05 | 1.00 | 0.00 | -0.48 |
| No. pupils in district cubed | 2.75E+13 | 9.02E+13 | -5.51E-15 | 1.00 | 0.00 | -1.21 |
| No. schools in district | 20.07 | 20.57 | 4.01E-02 | 1.04 | 0.04 | 1.03 |
| No. schools in district cubed | 53,438.62 | 1.87E+05 | 2.16E-06 | 1.00 | 0.00 | 0.56 |
| Rate of enrollment growth | 1.48 | 2.40 | -1.30E-02 | 0.99 | 0.05 | -0.25 |
| Ave. teachers' salary | 25,886.21 | 2,178.59 | -1.01E-04 | 1.00 | 0.00 | -1.73 |
| Inst. exp. /pupil | 1,913.55 | 220.06 | 5.44E-04 | 1.00 | 0.00 | 0.56 |
| Adm. exp./pupil | 204.52 | 41.15 | 3.93E-03 | 1.00 | 0.00 | 0.97 |
| Urban | 0.20 | 0.40 | -5.20E-01 | 0.59 | 0.26 | -1.17 |
| Rural | 0.05 | 0.22 | -1.24E+00 | 0.29 | 0.17 | -2.14 |
| Fraction students Black | 0.08 | 0.09 | -2.20E+00 | 0.11 | 0.18 | -1.36 |
| Fraction students Hispanic | 0.33 | 0.22 | -8.78E-01 | 0.42 | 0.38 | -0.96 |
| Fraction students Asian | 0.12 | 0.12 | -7.94E-01 | 0.45 | 0.79 | -0.45 |
| Fraction students Am Indian | 0.01 | 0.02 | 7.90E-01 | 2.20 | 9.39 | 0.19 |
| Fraction students Free lunch eligible | 0.33 | 0.20 | -1.55E+00 | 0.21 | 0.25 | -1.34 |
| Female | 0.42 | 0.49 | 1.01E-01 | 1.11 | 0.18 | 0.61 |
| No prior experience | 0.42 | 0.49 | -3.13E-01 | 0.73 | 0.16 | -1.47 |
| 1 - 3 yrs experience | 0.60 | 0.49 | -3.52E-01 | 0.70 | 0.31 | -0.79 |
| Total experience | 5.37 | 6.92 | 1.48E-01 | 1.16 | 0.08 | 2.14 |
| Total experience cubed | 1,680.72 | 6,582.36 | -7.93E-05 | 1.00 | 0.00 | -2.11 |
| Age | 35.86 | 10.01 | 2.89E-02 | 1.03 | 0.04 | 0.74 |
| Age cubed | 57,590.03 | 50,971.57 | -6.43E-06 | 1.00 | 0.00 | -0.84 |
| Education, BA or less | 0.24 | 0.43 | -1.27E+00 | 0.28 | 0.06 | -6.27 |
| Education, MA or more | 0.29 | 0.45 | -6.31E-01 | 0.53 | 0.13 | -2.62 |
| Asian | 0.08 | 0.27 | -2.77E-01 | 0.76 | 0.25 | -0.83 |
| Black | 0.04 | 0.20 | -6.02E-01 | 0.55 | 0.22 | -1.51 |
| Hispanic | 0.08 | 0.26 | -8.06E-01 | 0.45 | 0.12 | -3.12 |
| Am. Indian | 0.01 | 0.11 | -7.79E-02 | 0.93 | 0.93 | -0.08 |
| Race/ethnicity unknown | 0.01 | 0.09 | -6.69E-01 | 0.51 | 0.39 | -0.89 |
| Number of ob | | | 1,321 | | | |
| Chi2 | | | 158 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.3f

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1995 Will Have a Credential:
Grades 9-12 Other Teachers**

| | Mean | Std.Dev. | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.92 | 0.28 | 3.96 | | 2.33 | 1.70 |
| Population density | 1,315.40 | 2,244.13 | 5.07E-05 | 1.00 | 0.00 | 0.39 |
| Unemployment rate | 8.36 | 3.72 | 1.19E-02 | 1.01 | 0.04 | 0.30 |
| Ave. wage | 28,910.76 | 5,725.86 | -7.99E-05 | 1.00 | 0.00 | -1.52 |
| Federal wage | 39,071.32 | 5,566.64 | -1.80E-05 | 1.00 | 0.00 | -0.60 |
| Per capita income | 23,579.78 | 5,564.44 | 6.35E-05 | 1.00 | 0.00 | 1.61 |
| No. Pupils in district | 17,296.52 | 16,326.55 | -8.52E-06 | 1.00 | 0.00 | -0.29 |
| No. pupils in district cubed | 2.70E+13 | 8.48E+13 | -4.56E-15 | 1.00 | 0.00 | -1.41 |
| No. schools in district | 20.92 | 22.07 | 1.06E-02 | 1.01 | 0.03 | 0.41 |
| No. schools in district cubed | 63,730.04 | 2.14E+05 | 3.37E-06 | 1.00 | 0.00 | 1.20 |
| Rate of enrollment growth | 1.63 | 2.46 | -1.55E-02 | 0.98 | 0.04 | -0.41 |
| Ave. teachers' salary | 25,924.10 | 2,206.41 | -4.17E-05 | 1.00 | 0.00 | -1.01 |
| Inst. exp. /pupil | 1,921.18 | 224.98 | 1.04E-03 | 1.00 | 0.00 | 1.35 |
| Adm. exp./pupil | 206.27 | 43.43 | -2.45E-03 | 1.00 | 0.00 | -0.73 |
| Urban | 0.22 | 0.42 | 2.27E-01 | 1.26 | 0.40 | 0.72 |
| Rural | 0.06 | 0.24 | -1.11E+00 | 0.33 | 0.14 | -2.57 |
| Fraction students Black | 0.08 | 0.09 | -2.34E+00 | 0.10 | 0.12 | -1.83 |
| Fraction students Hispanic | 0.31 | 0.21 | -4.13E-01 | 0.66 | 0.46 | -0.60 |
| Fraction students Asian | 0.12 | 0.12 | -1.14E+00 | 0.32 | 0.40 | -0.91 |
| Fraction students Am Indian | 0.01 | 0.02 | 2.24E-01 | 1.25 | 4.44 | 0.06 |
| Fraction students Free lunch eligible | 0.33 | 0.20 | -1.11E+00 | 0.33 | 0.26 | -1.39 |
| Female | 0.55 | 0.50 | 1.92E-01 | 1.21 | 0.19 | 1.24 |
| No prior experience | 0.44 | 0.50 | -1.71E-01 | 0.84 | 0.21 | -0.69 |
| 1 - 3 yrs experience | 0.58 | 0.49 | 4.16E-01 | 1.52 | 0.61 | 1.03 |
| Total experience | 6.38 | 8.26 | 1.43E-01 | 1.15 | 0.09 | 1.85 |
| Total experience cubed | 2,605.08 | 7,995.04 | 4.28E-05 | 1.00 | 0.00 | 0.49 |
| Age | 36.71 | 10.57 | 7.32E-03 | 1.01 | 0.03 | 0.25 |
| Age cubed | 62,442.69 | 55,132.20 | 1.08E-06 | 1.00 | 0.00 | 0.17 |
| Education, BA or less | 0.23 | 0.42 | -1.51E+00 | 0.22 | 0.04 | -7.87 |
| Education, MA or more | 0.27 | 0.45 | -9.43E-01 | 0.39 | 0.08 | -4.75 |
| Asian | 0.05 | 0.21 | -6.40E-02 | 0.94 | 0.34 | -0.18 |
| Black | 0.04 | 0.19 | -4.57E-01 | 0.63 | 0.20 | -1.43 |
| Hispanic | 0.11 | 0.32 | -6.05E-01 | 0.55 | 0.12 | -2.80 |
| Am. Indian | 0.01 | 0.11 | -2.16E-01 | 0.81 | 0.65 | -0.27 |
| Race/ethnicity unknown | 0.01 | 0.09 | -1.06E+00 | 0.35 | 0.19 | -1.89 |
| Number of ob | | | 2,071 | | | |
| Chi2 | | | 271 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.4a

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1996 Will Have a Credential:
All Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.84 | 0.37 | 5.71 | | 1.18 | 4.83 |
| Population density | 1,365.47 | 1,918.79 | -6.59E-05 | 1.00 | 0.00 | -0.76 |
| Unemployment rate | 7.50 | 3.64 | -2.33E-02 | 0.98 | 0.02 | -0.97 |
| Ave. wage | 29,746.15 | 5,785.32 | 6.92E-06 | 1.00 | 0.00 | 0.23 |
| Federal wage | 40,654.88 | 5,005.38 | -2.91E-05 | 1.00 | 0.00 | -1.51 |
| Per capita income | 24,588.78 | 5,606.62 | 4.88E-06 | 1.00 | 0.00 | 0.19 |
| No. Pupils in district | 18,273.42 | 17,713.30 | -2.54E-05 | 1.00 | 0.00 | -0.98 |
| No. pupils in district cubed | 3.34E+13 | 1.03E+14 | -1.20E-15 | 1.00 | 0.00 | -0.58 |
| No. schools in district | 22.75 | 21.38 | 2.70E-02 | 1.03 | 0.02 | 1.19 |
| No. schools in district cubed | 62,206.43 | 1.92E+05 | -4.56E-07 | 1.00 | 0.00 | -0.30 |
| Rate of enrollment growth | 1.35 | 2.32 | 2.72E-02 | 1.03 | 0.03 | 0.93 |
| Ave. teachers' salary | 25,864.26 | 2,113.78 | -4.54E-05 | 1.00 | 0.00 | -1.51 |
| Inst. exp. /pupil | 2,037.25 | 189.35 | 4.25E-04 | 1.00 | 0.00 | 1.05 |
| Adm. exp./pupil | 209.97 | 35.39 | -3.84E-05 | 1.00 | 0.00 | -0.02 |
| Urban | 0.21 | 0.41 | -1.00E-01 | 0.90 | 0.18 | -0.52 |
| Rural | 0.05 | 0.22 | 4.38E-01 | 1.55 | 0.47 | 1.44 |
| Fraction students Black | 0.08 | 0.09 | -2.71E+00 | 0.07 | 0.06 | -3.01 |
| Fraction students Hispanic | 0.36 | 0.23 | -2.05E+00 | 0.13 | 0.06 | -4.50 |
| Fraction students Asian | 0.11 | 0.11 | 4.17E-01 | 1.52 | 1.32 | 0.48 |
| Fraction students Am Indian | 0.01 | 0.02 | -2.88E+00 | 0.06 | 0.10 | -1.65 |
| Fraction students Free lunch eligible | 0.43 | 0.22 | 1.68E-01 | 1.18 | 0.56 | 0.35 |
| Female | 0.75 | 0.43 | 3.28E-01 | 1.39 | 0.07 | 6.19 |
| No prior experience | 0.53 | 0.50 | -6.40E-01 | 0.53 | 0.04 | -8.15 |
| 1 – 3 yrs experience | 0.68 | 0.47 | -2.05E-01 | 0.81 | 0.10 | -1.67 |
| Total experience | 4.51 | 6.48 | 8.21E-02 | 1.09 | 0.02 | 3.92 |
| Total experience cubed | 1,364.41 | 5,644.00 | 5.17E-06 | 1.00 | 0.00 | 0.22 |
| Age | 34.92 | 9.84 | -2.83E-02 | 0.97 | 0.01 | -2.89 |
| Age cubed | 53,437.42 | 47,868.74 | 7.30E-06 | 1.00 | 0.00 | 3.44 |
| Education, BA or less | 0.31 | 0.46 | -1.61E+00 | 0.20 | 0.01 | -23.23 |
| Education, MA or more | 0.17 | 0.38 | -6.53E-01 | 0.52 | 0.04 | -8.58 |
| Asian | 0.05 | 0.22 | -1.23E-01 | 0.88 | 0.08 | -1.28 |
| Black | 0.04 | 0.20 | -6.29E-01 | 0.53 | 0.07 | -4.77 |
| Hispanic | 0.14 | 0.35 | -6.57E-01 | 0.52 | 0.04 | -9.33 |
| Am. Indian | 0.01 | 0.09 | -7.25E-02 | 0.93 | 0.27 | -0.25 |
| Race/ethnicity unknown | 0.01 | 0.07 | -6.14E-02 | 0.94 | 0.33 | -0.17 |
| Number of ob | | | 22,647 | | | |
| Chi2 | | | 1,667 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.4b

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1996 Will Have a Credential:
K-3 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.83 | 0.37 | 6.21 | | 1.78 | 3.48 |
| Population density | 1,393.83 | 1,849.45 | -1.07E-04 | 1.00 | 0.00 | -1.09 |
| Unemployment rate | 7.42 | 3.51 | 3.80E-04 | 1.00 | 0.03 | 0.01 |
| Ave. wage | 29,715.85 | 5,609.33 | 3.78E-05 | 1.00 | 0.00 | 1.01 |
| Federal wage | 40,666.48 | 5,010.62 | -4.50E-05 | 1.00 | 0.00 | -1.84 |
| Per capita income | 24,565.00 | 5,392.39 | 9.15E-06 | 1.00 | 0.00 | 0.29 |
| No. Pupils in district | 18,356.66 | 18,070.24 | -1.77E-05 | 1.00 | 0.00 | -0.55 |
| No. pupils in district cubed | 3.49E+13 | 1.06E+14 | -1.76E-15 | 1.00 | 0.00 | -0.68 |
| No. schools in district | 23.32 | 21.26 | 1.81E-02 | 1.02 | 0.03 | 0.65 |
| No. schools in district cubed | 62,672.02 | 1.88E+05 | -3.75E-07 | 1.00 | 0.00 | -0.20 |
| Rate of enrollment growth | 1.35 | 2.27 | 3.22E-02 | 1.03 | 0.04 | 0.88 |
| Ave. teachers' salary | 25,789.76 | 2,095.99 | -3.37E-05 | 1.00 | 0.00 | -0.88 |
| Inst. exp. /pupil | 2,037.38 | 177.02 | 3.04E-04 | 1.00 | 0.00 | 0.60 |
| Adm. exp./pupil | 208.56 | 33.42 | -3.90E-04 | 1.00 | 0.00 | -0.16 |
| Urban | 0.21 | 0.41 | -1.02E-01 | 0.90 | 0.23 | -0.41 |
| Rural | 0.05 | 0.22 | 7.40E-01 | 2.10 | 0.90 | 1.72 |
| Fraction students Black | 0.08 | 0.09 | -3.10E+00 | 0.04 | 0.05 | -2.80 |
| Fraction students Hispanic | 0.37 | 0.24 | -2.59E+00 | 0.07 | 0.04 | -4.33 |
| Fraction students Asian | 0.10 | 0.11 | 1.09E+00 | 2.97 | 3.63 | 0.889 |
| Fraction students Am Indian | 0.01 | 0.02 | 2.81E+00 | 16.55 | 135.56 | 0.343 |
| Fraction students Free lunch eligible | 0.45 | 0.22 | 2.44E-01 | 1.28 | 0.85 | 0.36 |
| Female | 0.90 | 0.30 | 3.25E-01 | 1.38 | 0.13 | 3.43 |
| No prior experience | 0.56 | 0.50 | -8.30E-01 | 0.44 | 0.05 | -7.68 |
| 1 - 3 yrs experience | 0.71 | 0.45 | -3.09E-01 | 0.73 | 0.13 | -1.70 |
| Total experience | 3.99 | 5.82 | 5.82E-02 | 1.06 | 0.03 | 2.09 |
| Total experience cubed | 1,034.97 | 4,879.36 | 1.51E-05 | 1.00 | 0.00 | 0.43 |
| Age | 34.40 | 9.63 | -4.87E-02 | 0.95 | 0.02 | -3.02 |
| Age cubed | 50,978.96 | 46,051.86 | 1.18E-05 | 1.00 | 0.00 | 3.11 |
| Education, BA or less | 0.32 | 0.47 | -1.62E+00 | 0.20 | 0.02 | -16.59 |
| Education, MA or more | 0.13 | 0.34 | -4.90E-01 | 0.61 | 0.08 | -3.58 |
| Asian | 0.05 | 0.22 | -1.12E-01 | 0.89 | 0.14 | -0.71 |
| Black | 0.03 | 0.18 | -7.64E-01 | 0.47 | 0.07 | -4.96 |
| Hispanic | 0.16 | 0.37 | -6.98E-01 | 0.50 | 0.04 | -7.93 |
| Am. Indian | 0.01 | 0.07 | -9.50E-02 | 0.91 | 0.41 | -0.21 |
| Race/ethnicity unknown | 0.00 | 0.06 | -1.65E-01 | 0.85 | 0.40 | -0.35 |
| Number of ob | | | 11,305 | | | |
| Chi2 | | | 1,099 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.4c

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1996 Will Have a Credential:
Grade 4-6 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.85 | 0.35 | 7.20 | | 2.05 | 3.51 |
| Population density | 1,269.76 | 1,464.11 | -1.38E-02 | 1.00 | 0.00 | 0.01 |
| Unemployment rate | 7.64 | 3.66 | 8.42E-07 | 0.99 | 0.03 | -0.39 |
| Ave. wage | 29,520.47 | 5,676.52 | -2.37E-05 | 1.00 | 0.00 | 0.02 |
| Federal wage | 40,480.06 | 4,973.80 | 1.61E-05 | 1.00 | 0.00 | -0.93 |
| Per capita income | 24,222.04 | 5,403.51 | -7.52E-06 | 1.00 | 0.00 | 0.39 |
| No. Pupils in district | 17,478.90 | 17,067.78 | -1.22E-15 | 1.00 | 0.00 | -0.17 |
| No. pupils in district cubed | 2.97E+13 | 9.55E+13 | -6.45E-03 | 1.00 | 0.00 | -0.30 |
| No. schools in district | 22.21 | 19.88 | 1.32E-06 | 0.99 | 0.04 | -0.16 |
| No. schools in district cubed | 51,455.37 | 1.50E+05 | 6.91E-02 | 1.00 | 0.00 | 0.38 |
| Rate of enrollment growth | 1.27 | 2.31 | -6.38E-05 | 1.07 | 0.05 | 1.60 |
| Ave. teachers' salary | 25,929.52 | 2,079.16 | 2.58E-04 | 1.00 | 0.00 | -1.34 |
| Inst. exp. /pupil | 2,022.14 | 186.20 | -1.32E-03 | 1.00 | 0.00 | 0.45 |
| Adm. exp./pupil | 207.94 | 33.20 | 2.73E-01 | 1.00 | 0.00 | -0.46 |
| Urban | 0.21 | 0.41 | 6.56E-01 | 1.31 | 0.42 | 0.85 |
| Rural | 0.06 | 0.23 | -1.69E+00 | 1.93 | 0.73 | 1.73 |
| Fraction students Black | 0.08 | 0.09 | -2.29E+00 | 0.18 | 0.21 | -1.50 |
| Fraction students Hispanic | 0.38 | 0.24 | 9.73E-01 | 0.10 | 0.06 | -3.86 |
| Fraction students Asian | 0.10 | 0.10 | -1.09E-01 | 2.65 | 3.45 | 0.75 |
| Fraction students Am Indian | 0.01 | 0.02 | -8.85E-02 | 0.90 | 2.93 | -0.03 |
| Fraction students Free lunch eligible | 0.46 | 0.22 | 3.21E-01 | 0.92 | 0.57 | -0.14 |
| Female | 0.75 | 0.43 | -3.07E-01 | 1.38 | 0.17 | 2.59 |
| No prior experience | 0.55 | 0.50 | -3.83E-01 | 0.74 | 0.15 | -1.54 |
| 1 - 3 yrs experience | 0.69 | 0.46 | 4.43E-02 | 0.68 | 0.24 | -1.08 |
| Total experience | 4.33 | 6.31 | 7.91E-05 | 1.05 | 0.07 | 0.65 |
| Total experience cubed | 1,268.40 | 5,286.51 | -4.19E-02 | 1.00 | 0.00 | 0.89 |
| Age | 34.66 | 9.59 | 8.99E-06 | 0.96 | 0.03 | -1.40 |
| Age cubed | 51,867.43 | 45,814.45 | -1.63E+00 | 1.00 | 0.00 | 1.39 |
| Education, BA or less | 0.31 | 0.46 | -5.55E-01 | 0.20 | 0.03 | -10.31 |
| Education, MA or more | 0.14 | 0.35 | -3.76E-01 | 0.57 | 0.15 | -2.10 |
| Asian | 0.04 | 0.20 | -5.73E-01 | 0.69 | 0.18 | -1.41 |
| Black | 0.05 | 0.21 | -6.56E-01 | 0.56 | 0.13 | -2.47 |
| Hispanic | 0.13 | 0.34 | 1.26E-01 | 0.52 | 0.09 | -3.92 |
| Am. Indian | 0.01 | 0.09 | 1.54E-01 | 1.13 | 0.93 | 0.15 |
| Race/ethnicity unknown | 0.01 | 0.09 | 7.20E+00 | 1.17 | 0.81 | 0.22 |
| Number of ob | | | 3,119 | | | |
| Chi2 | | | 439 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.4d

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1996 Will Have a Credential:
Grade 6-8 Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.85 | 0.36 | 5.57 | | 1.55 | 3.59 |
| Population density | 1,415.44 | 2,257.44 | -6.60E-05 | 1.00 | 0.00 | -0.66 |
| Unemployment rate | 7.50 | 3.67 | -4.38E-02 | 0.96 | 0.03 | -1.54 |
| Ave. wage | 29,848.54 | 5,855.08 | 5.75E-07 | 1.00 | 0.00 | 0.02 |
| Federal wage | 40,903.34 | 4,867.29 | -4.21E-05 | 1.00 | 0.00 | -1.74 |
| Per capita income | 24,802.71 | 5,943.83 | -5.67E-06 | 1.00 | 0.00 | -0.19 |
| No. Pupils in district | 18,794.81 | 18,740.87 | 7.62E-06 | 1.00 | 0.00 | 0.22 |
| No. pupils in district cubed | 3.81E+13 | 1.11E+14 | -3.21E-15 | 1.00 | 0.00 | -1.21 |
| No. schools in district | 23.65 | 22.92 | 5.26E-03 | 1.01 | 0.03 | 0.18 |
| No. schools in district cubed | 74,115.70 | 2.23E+05 | 8.83E-07 | 1.00 | 0.00 | 0.47 |
| Rate of enrollment growth | 1.40 | 2.49 | -1.05E-02 | 0.99 | 0.04 | -0.30 |
| Ave. teachers' salary | 25,990.59 | 2,185.52 | -8.19E-05 | 1.00 | 0.00 | -2.09 |
| Inst. exp. /pupil | 2,034.71 | 199.53 | 9.14E-04 | 1.00 | 0.00 | 1.66 |
| Adm. exp./pupil | 211.20 | 33.77 | 3.37E-03 | 1.00 | 0.00 | 1.18 |
| Urban | 0.21 | 0.41 | -8.96E-02 | 0.91 | 0.18 | -0.45 |
| Rural | 0.05 | 0.22 | 3.55E-01 | 1.43 | 0.52 | 0.97 |
| Fraction students Black | 0.09 | 0.10 | -2.34E+00 | 0.10 | 0.09 | -2.58 |
| Fraction students Hispanic | 0.36 | 0.23 | -9.26E-01 | 0.40 | 0.25 | -1.47 |
| Fraction students Asian | 0.11 | 0.12 | 5.79E-02 | 1.06 | 1.02 | 0.06 |
| Fraction students Am Indian | 0.01 | 0.02 | -3.83E+00 | 0.02 | 0.05 | -1.80 |
| Fraction students Free lunch eligible | 0.44 | 0.22 | -7.18E-01 | 0.49 | 0.32 | -1.10 |
| Female | 0.60 | 0.49 | 2.64E-01 | 1.30 | 0.14 | 2.53 |
| No prior experience | 0.47 | 0.50 | -6.60E-01 | 0.52 | 0.10 | -3.37 |
| 1 - 3 yrs experience | 0.64 | 0.48 | -1.41E-01 | 0.87 | 0.25 | -0.48 |
| Total experience | 5.02 | 6.89 | 1.16E-01 | 1.12 | 0.05 | 2.42 |
| Total experience cubed | 1,623.32 | 6,321.60 | -2.34E-05 | 1.00 | 0.00 | -0.54 |
| Age | 35.58 | 9.91 | -9.28E-03 | 0.99 | 0.02 | -0.37 |
| Age cubed | 56,145.21 | 48,585.45 | 2.45E-06 | 1.00 | 0.00 | 0.44 |
| Education, BA or less | 0.28 | 0.45 | -1.57E+00 | 0.21 | 0.03 | -10.92 |
| Education, MA or more | 0.21 | 0.41 | -9.21E-01 | 0.40 | 0.07 | -5.50 |
| Asian | 0.05 | 0.22 | -1.55E-01 | 0.86 | 0.20 | -0.67 |
| Black | 0.06 | 0.24 | -7.33E-01 | 0.48 | 0.13 | -2.72 |
| Hispanic | 0.11 | 0.31 | -5.98E-01 | 0.55 | 0.08 | -4.15 |
| Am. Indian | 0.01 | 0.10 | -1.04E+00 | 0.35 | 0.21 | -1.72 |
| Race/ethnicity unknown | 0.01 | 0.09 | 6.74E-01 | 1.96 | 1.26 | 1.05 |
| Number of ob | | | 3,202 | | | |
| Chi2 | | | 508 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.4e

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1996 Will Have a Credential:
Grade 9-12 Math Science Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.80 | 0.40 | 4.65 | | 1.97 | 2.36 |
| Population density | 1,364.84 | 2,075.86 | -8.89E-05 | 1.00 | 0.00 | -0.71 |
| Unemployment rate | 7.44 | 3.84 | -8.86E-03 | 0.99 | 0.04 | -0.22 |
| Ave. wage | 30,357.32 | 6,256.96 | -9.26E-05 | 1.00 | 0.00 | -2.16 |
| Federal wage | 40,793.01 | 4,882.00 | -1.61E-05 | 1.00 | 0.00 | -0.45 |
| Per capita income | 25,024.22 | 6,019.70 | 7.56E-05 | 1.00 | 0.00 | 1.66 |
| No. Pupils in district | 18,917.45 | 16,541.78 | -1.44E-05 | 1.00 | 0.00 | -0.45 |
| No. pupils in district cubed | 2.98E+13 | 8.88E+13 | -5.01E-15 | 1.00 | 0.00 | -2.09 |
| No. schools in district | 21.91 | 21.55 | 4.89E-02 | 1.05 | 0.03 | 1.74 |
| No. schools in district cubed | 61,798.54 | 2.01E+05 | -3.66E-07 | 1.00 | 0.00 | -0.18 |
| Rate of enrollment growth | 1.41 | 2.34 | 9.47E-02 | 1.10 | 0.04 | 2.46 |
| Ave. teachers' salary | 25,928.65 | 2,084.15 | -1.11E-04 | 1.00 | 0.00 | -2.40 |
| Inst. exp. /pupil | 2,048.54 | 210.05 | 1.02E-03 | 1.00 | 0.00 | 1.67 |
| Adm. exp./pupil | 213.24 | 39.87 | 1.60E-03 | 1.00 | 0.00 | 0.42 |
| Urban | 0.22 | 0.42 | -5.40E-01 | 0.58 | 0.20 | -1.57 |
| Rural | 0.05 | 0.21 | -4.42E-01 | 0.64 | 0.35 | -0.81 |
| Fraction students Black | 0.08 | 0.09 | -1.92E+00 | 0.15 | 0.20 | -1.42 |
| Fraction students Hispanic | 0.35 | 0.22 | -1.02E+00 | 0.36 | 0.34 | -1.07 |
| Fraction students Asian | 0.12 | 0.12 | 4.66E-01 | 1.59 | 1.67 | 0.45 |
| Fraction students Am Indian | 0.01 | 0.01 | 6.44E-01 | 1.90 | 19.71 | 0.06 |
| Fraction students Free lunch eligible | 0.35 | 0.21 | -8.37E-01 | 0.43 | 0.44 | -0.83 |
| Female | 0.41 | 0.49 | 2.88E-01 | 1.33 | 0.20 | 1.90 |
| No prior experience | 0.46 | 0.50 | -3.84E-01 | 0.68 | 0.15 | -1.74 |
| 1 – 3 yrs experience | 0.63 | 0.48 | 2.69E-01 | 1.31 | 0.56 | 0.62 |
| Total experience | 5.19 | 7.02 | 2.12E-01 | 1.24 | 0.12 | 2.19 |
| Total experience cubed | 1,685.21 | 5,908.97 | 6.01E-06 | 1.00 | 0.00 | 0.04 |
| Age | 35.79 | 10.10 | -3.82E-02 | 0.96 | 0.03 | -1.13 |
| Age cubed | 57,446.09 | 50,301.10 | 1.07E-05 | 1.00 | 0.00 | 1.55 |
| Education, BA or less | 0.29 | 0.46 | -1.54E+00 | 0.21 | 0.04 | -8.69 |
| Education, MA or more | 0.28 | 0.45 | -3.54E-01 | 0.70 | 0.16 | -1.59 |
| Asian | 0.08 | 0.27 | -9.36E-02 | 0.91 | 0.23 | -0.37 |
| Black | 0.04 | 0.20 | -5.25E-01 | 0.59 | 0.22 | -1.39 |
| Hispanic | 0.09 | 0.29 | -1.81E-01 | 0.83 | 0.20 | -0.76 |
| Am. Indian | 0.01 | 0.11 | 8.37E-01 | 2.31 | 1.60 | 1.20 |
| Race/ethnicity unknown | 0.00 | 0.06 | -6.71E-01 | 0.51 | 0.19 | -1.77 |
| Number of ob | | | 1,590 | | | |
| Chi2 | | | 524 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 4.4f

**Logistic Regression Results: Odds That Teachers
Newly Hired in 1996 Will Have a Credential:
Grade 9-12 Other Teachers**

| | Mean | St. Dev | Coef. | Odds Ratio | Std. Error | z-score |
|---------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.85 | 0.35 | 3.69 | | 1.38 | 2.67 |
| Population density | 1,312.70 | 2,078.15 | -8.86E-05 | 1.00 | 0.00 | -0.79 |
| Unemployment rate | 7.67 | 3.93 | -5.25E-02 | 0.95 | 0.03 | -1.48 |
| Ave. wage | 29,672.31 | 6,133.90 | -3.17E-06 | 1.00 | 0.00 | -0.09 |
| Federal wage | 40,479.67 | 5,187.35 | -5.26E-06 | 1.00 | 0.00 | -0.23 |
| Per capita income | 24,599.10 | 5,929.16 | -1.51E-05 | 1.00 | 0.00 | -0.45 |
| No. Pupils in district | 17,936.41 | 16,580.67 | -1.92E-05 | 1.00 | 0.00 | -0.69 |
| No. pupils in district cubed | 2.92E+13 | 9.37E+13 | -2.17E-15 | 1.00 | 0.00 | -0.91 |
| No. schools in district | 20.93 | 21.39 | 3.67E-02 | 1.04 | 0.02 | 1.57 |
| No. schools in district cubed | 59,520.35 | 2.01E+05 | -4.80E-09 | 1.00 | 0.00 | 0.00 |
| Rate of enrollment growth | 1.34 | 2.30 | 3.93E-02 | 1.04 | 0.04 | 1.08 |
| Ave. teachers' salary | 25,902.71 | 2,140.45 | 1.62E-06 | 1.00 | 0.00 | 0.04 |
| Inst. exp. /pupil | 2,047.68 | 209.68 | 1.08E-04 | 1.00 | 0.00 | 0.22 |
| Adm. exp./pupil | 213.80 | 41.85 | 1.66E-03 | 1.00 | 0.00 | 0.69 |
| Urban | 0.19 | 0.39 | -3.11E-01 | 0.73 | 0.20 | -1.16 |
| Rural | 0.06 | 0.24 | 2.54E-01 | 1.29 | 0.55 | 0.59 |
| Fraction students Black | 0.07 | 0.08 | -2.17E+00 | 0.11 | 0.12 | -2.02 |
| Fraction students Hispanic | 0.34 | 0.22 | -3.25E-01 | 0.72 | 0.50 | -0.47 |
| Fraction students Asian | 0.12 | 0.12 | -6.59E-01 | 0.52 | 0.52 | -0.66 |
| Fraction students Am Indian | 0.01 | 0.02 | -4.44E+00 | 0.01 | 0.04 | -1.36 |
| Fraction students Free lunch eligible | 0.35 | 0.21 | -1.21E+00 | 0.30 | 0.22 | -1.65 |
| Female | 0.53 | 0.50 | 1.91E-01 | 1.21 | 0.12 | 1.88 |
| No prior experience | 0.48 | 0.50 | -6.02E-01 | 0.55 | 0.10 | -3.37 |
| 1 - 3 yrs experience | 0.63 | 0.48 | -6.33E-02 | 0.94 | 0.30 | -0.20 |
| Total experience | 5.59 | 7.72 | 8.05E-02 | 1.08 | 0.06 | 1.52 |
| Total experience cubed | 2,146.87 | 7,203.41 | -3.21E-06 | 1.00 | 0.00 | -0.08 |
| Age | 35.87 | 10.42 | 1.58E-03 | 1.00 | 0.02 | 0.08 |
| Age cubed | 58,580.39 | 52,852.23 | 1.62E-06 | 1.00 | 0.00 | 0.35 |
| Education, BA or less | 0.27 | 0.44 | -1.64E+00 | 0.19 | 0.03 | -12.43 |
| Education, MA or more | 0.25 | 0.43 | -7.57E-01 | 0.47 | 0.08 | -4.69 |
| Asian | 0.04 | 0.19 | 2.28E-01 | 1.26 | 0.38 | 0.75 |
| Black | 0.04 | 0.20 | -3.29E-01 | 0.72 | 0.21 | -1.12 |
| Hispanic | 0.14 | 0.34 | -6.36E-01 | 0.53 | 0.07 | -4.84 |
| Am. Indian | 0.01 | 0.10 | 7.75E-01 | 2.17 | 1.38 | 1.22 |
| Race/ethnicity unknown | 0.01 | 0.08 | -6.03E-01 | 0.55 | 0.36 | -0.91 |
| Number of ob | | | 3,431 | | | |
| Chi2 | | | 466 | | | |
| Prob > chi2 | | | 0.000 | | | |

Of particular interest, the average teachers' salary in a district did not significantly affect the district's relative attractiveness to credentialed teachers who were not employed in the district the previous year.

The Total Supply of Teachers from Outside the District

Tables 4.5 and 4.6 present the empirical results for a model of the district's ability to attract teachers, regardless of their qualifications, in 1995 and 1996, respectively. The dependent variable in each case is the ratio of the number of newly hired teachers, both credentialed and not credentialed, to the sum of the number of newly hired teachers plus the number of vacant teaching positions in the district. In other words, it is the fraction of the hiring target that was met, regardless of the qualifications of the newly hired teachers.

Table 4.5

**Regression Results: Fraction of New Hire Target Achieved,
1995**

| | Mean | St. Dev. | Coef | t-statistic |
|---------------------------------------|----------|-----------|--------|-------------|
| Dependent Variable/Constant | 0.94 | 0.18 | 1.13 | 11.59 |
| Ave. teachers' salary (\$000s) | 25.16 | 2.28 | -0.00 | -0.34 |
| Suburban | 0.65 | 0.48 | -0.03 | -1.34 |
| Rural | 0.23 | 0.42 | -0.17 | -0.67 |
| Fraction students Black | 0.04 | 0.07 | -0.163 | -1.52 |
| Fraction students Hispanic | 0.29 | 0.25 | -0.14 | -3.67 |
| Fraction students Asian | 0.06 | 0.09 | -0.69 | -0.75 |
| Fraction students Amer. Indian | 0.02 | 0.05 | -0.31 | -2.13 |
| Fraction students free lunch eligible | 0.40 | 0.25 | 0.00 | 0.20 |
| Growth | 0.01 | 0.03 | 0.03 | 0.16 |
| No. pupils (000s) | 5.99 | 23.43 | 0.01 | 0.25 |
| No. pupils (000s) cubed | 3.02E+11 | 8.67E+12 | -0.00 | -0.42 |
| No. schools | 8.55 | 24.86 | -0.01 | -2.38 |
| No. schools squared | 690 | 14,171 | 0.00 | 2.14 |
| No. schools cubed | 323,899 | 9,087,349 | -0.00 | -0.68 |
| Ave. wage, all industries (\$000s) | 25.28 | 5.12 | 0.00 | 1.62 |
| Ave. wage, federal employees (\$000s) | 35.95 | 5.20 | -0.00 | -2.56 |
| Unemployment rate | 10.51 | 4.17 | -0.00 | -0.53 |
| Population density (000s) | 1.59 | 1.00 | -0.00 | -0.1) |
| No. of observations | | | 856 | |
| R Square | | | 0.09 | |
| F (19, 836) | | | 4.24 | |
| Significance of the regression | | | 0.0000 | |

Table 4.6

**Regression Results: Fraction of New Hire Target Achieved,
1996**

| | Mean | St. Dev. | Coef | t-statistic |
|---------------------------------------|----------|-----------|-------|-------------|
| Dependent Variable/Constant | 0.94 | 0.20 | 0.963 | 9.02 |
| Ave. teachers' salary (\$000s) | 25.80 | 2.30 | 0.00 | 0.99 |
| Suburban | 0.67 | 0.47 | 0.00 | 0.00 |
| Rural | 0.20 | 0.40 | -0.01 | -0.35 |
| Fraction students Black | 0.04 | 0.07 | -0.07 | -0.59 |
| Fraction students Hispanic | 0.29 | 0.25 | -0.10 | -2.23 |
| Fraction students Asian | 0.06 | 0.09 | -0.16 | -1.55 |
| Fraction students Amer. Indian | 0.02 | 0.06 | 0.091 | 0.68 |
| Fraction students free lunch eligible | 0.41 | 0.25 | -0.04 | -0.88 |
| Growth | 0.01 | 0.03 | -0.09 | -0.41 |
| No. pupils (000s) | 6.06 | 23.97 | 0.00 | 0.61 |
| No. pupils (000s) cubed | 3.24E+11 | 9.28E+12 | -0.00 | -0.40 |
| No. schools | 8.53 | 24.87 | -0.01 | -1.63 |
| No. schools squared | 690 | 14,130 | 0.00 | 1.62 |
| No. schools cubed | 322,900 | 9,045,195 | -0.00 | -0.60 |
| Ave. wage, all industries (\$000s) | 25.88 | 5.61 | -0.00 | -0.24 |
| Ave. wage, federal employees (\$000s) | 36.57 | 5.94 | -0.00 | -0.6) |
| Unemployment rate | 10.09 | 4.67 | 0.00 | 1.29 |
| Population density (000s) | 1.60 | 1.01 | -0.00 | -0.24 |
| No. of observations | 856 | | | |
| R Square | 0.05 | | | |
| F (19, 836) | 2.38 | | | |
| Significance of the regression | 0.0008 | | | |

The variables measuring district and student characteristics are generally insignificant. The important result, from the perspective of this study, is that the only student characteristic that had a significant effect on the distribution of vacancies among districts in both years is the percent of the pupils that are Hispanic. Districts serving disproportionate numbers of Hispanic students found it more difficult to fill teaching positions than did other districts. Otherwise, there is no evidence that districts serving different pupil populations have systematically different success in recruiting the teachers they need to achieve their hiring targets. Hence, differences in the distributions of teachers serving different student populations are not a product of differences in districts' demands for teachers.

CONCLUSIONS

Table 4.7 summarizes our results in terms of the effects of the principal policy variables and student characteristics on the likelihood that a teacher employed in a district will return to the district the following year. The entries in Table 4.7 indicate the direction and significance of the effect of the effect: A positive (negative) sign indicates that an increase in the magnitude of the variable increases the likelihood that a teacher will leave (remain in) the district. A single entry (+ or -) indicates that the result is not statistically significant (two-tailed test) at the 95 percent level. A doubled entry (++) or (-) indicates that the result is statistically significant.

Table 4.7
Odds That Teachers Will Leave Their District

| | All | K-3 | 4-6 | 6-8 | 9-12 Math & Science | 9-12 Other |
|--------------------------------------|-----|-----|-----|-----|---------------------------|---------------|
| 1994 | | | | | | |
| Inst. Exp./pupil | - | -- | - | + | - | + |
| Adm. Exp./pupil | + | ++ | - | - | - | + |
| Maximum teacher's salary | -- | - | - | - | -- | + |
| Fraction nonwhite pupils in district | - | - | + | - | - | + |
| Pct. students Black | ++ | ++ | ++ | ++ | ++ | + |
| Pct. students Hispanic | ++ | ++ | + | + | ++ | - |
| Pct. students Asian | - | + | + | - | - | -- |
| Pct. students Am Indian | + | - | + | + | - | - |
| Pct. students Free lunch eligible | -- | - | + | - | + | + |
| 1995 | | | | | | |
| Inst. Exp./pupil | + | - | - | + | + | + |
| Adm. Exp./pupil | ++ | ++ | - | + | - | + |
| Maximum teacher's salary | -- | -- | -- | -- | - | + |
| Fraction nonwhite pupils in district | + | + | + | - | + | + |
| Pct. students Black | ++ | ++ | ++ | ++ | + | ++ |
| Pct. students Hispanic | ++ | + | + | + | - | + |
| Pct. students Asian | - | - | -- | + | -- | - |
| Pct. students Am Indian | + | + | + | ++ | - | + |
| Pct. students Free lunch eligible | - | - | + | - | ++ | ++ |

The relationship between the proportion of a school's students who are Black and the likelihood that a teacher in that school will not return to the district is clear. The odds that a teacher will leave the district are significantly positively related to the percent

Black in the teacher's school for all teachers combined and for the teachers in each of the five separate grade level groups in both of the transition years included in our data. The magnitude of the effect varies somewhat between years and grade levels.

There are no consistent patterns in the relationships between the other descriptors of the student population in a school and the likelihood that a teacher from that school will leave the district. The odds that a teacher will leave a district are significantly related to other measures of the pupil population in one or the other year included in our data for the teachers in some grades. However, there are no consistent patterns in the relationships between the other descriptors of the student population in a school and the likelihood that a teacher from that school will leave the district.

Tables 4.8 and 4.9 summarize our results regarding the effects of the policy and student characteristic variables on a district's ability to recruit fully qualified teachers or teachers in general, whether fully qualified or not.

Table 4.8

**Odds That Newly Hired Teachers
in a District Will Have a Credential:**

| | All | K-3 | 4-6 | 6-8 | 9-12 Math & Science | 9-12 Other |
|-----------------------------------|-----|-----|-----|-----|---------------------------|---------------|
| 1995 | | | | | | |
| Inst. Exp./pupil | - | + | + | - | + | + |
| Adm. Exp./pupil | + | + | - | + | + | - |
| Average teacher's salary | - | + | ++ | - | - | - |
| Pct. students Black | -- | -- | - | - | - | - |
| Pct. students Hispanic | -- | -- | - | - | - | - |
| Pct. students Asian | + | + | + | + | - | - |
| Pct. students Am Indian | - | - | - | - | + | + |
| Pct. students Free lunch eligible | - | - | - | - | - | - |
| 1996 | | | | | | |
| Inst. Exp./pupil | + | + | + | + | + | + |
| Adm. Exp./pupil | - | - | - | + | + | + |
| Average teacher's salary | - | - | - | -- | -- | + |
| Pct. students Black | -- | -- | - | -- | - | -- |
| Pct. students Hispanic | -- | -- | -- | - | - | - |
| Pct. students Asian | + | + | + | + | + | - |
| Pct. students Am Indian | - | + | - | - | + | - |
| Pct. students Free lunch eligible | + | + | - | - | - | - |

Table 4.9

Regression Results: Fraction of New Hire Target Achieved,

| | 1995 | 1996 |
|-----------------------------------|------|------|
| Average teacher's salary | - | + |
| Pct. students Black | - | - |
| Pct. students Hispanic | -- | -- |
| Pct. students Asian | - | - |
| Pct. students Am Indian | -- | + |
| Pct. students Free lunch eligible | + | - |

The racial/ethnic distribution of the students in a district was significantly related to either the district's ability to recruit credentialed teachers or its ability to meet its hiring targets in one or the other year for which we have data in some grade levels. However, none of the variables measuring students' characteristics had a consistent, significant effect on

either the fraction of newly hired teachers in a district who were credentialed or the fraction of the district's hiring goal it was able to meet.

There is no consistent, significant relationship between the average teachers' salary in a district and the movements of teachers out of or into that district.

5. THE SUPPLY OF TEACHERS TO SCHOOLS

OVERVIEW

We present a basic model of the labor market for teachers within districts. We then use our data for our sample of California school districts to examine the degree to which the flows of teachers into and out of schools within a district are influenced by the characteristics of the school's students. We examine the extent to which the distributions of credentialed staff, underqualified staff, and vacancies among schools serving diverse student populations reflect the influence of student characteristics on districts' and teachers' decisions.

We assume that the district determines the number of teaching positions it will assign to any particular school based its enrollments and district preferences regarding the appropriate distribution of teachers among different types of pupils. Specifically, we assume the district determines the district-wide desired teacher/pupil ratio as described above. Given the district-wide staff ratio and the number and characteristics of pupils at a school, the district determines the number of teaching positions it will allot to that school.

The supply of teachers to a school includes individuals drawn from three different pools. The primary source of teachers to a school is the pool of teachers employed in the school the previous year. Custom, and, in many cases, the contract between the teachers' union and the district, generally provide that returning teachers have priority on the positions they held the prior year. Each year, most schools fill the large majority of their teaching positions with returning staff.

The second source of teachers to a school is the pool of teachers employed in other schools in the district. Enrollment growth and the movement of teachers out of the district create vacancies throughout the district. Here, too, custom, and, often, the

contract between the teachers' union and the district, generally provide that returning teachers, in order of seniority, have priority on transfers to vacant positions within the district.

The third source of teachers to a school is the pool of newly hired teachers. The district recruits teachers from outside the district, decides which applicants will be employed, and assigns newly hired teachers to the positions left vacant after returning teachers have distributed themselves throughout the district.

The supply of teachers returning to a district to a school reflects individuals' choices regarding working conditions. A teacher's salary is determined at the district level and is independent of the particular school in the district in which the teacher is employed.¹⁹ We assume that returning teachers distribute themselves throughout the district in accordance with their preferences. The supply of newly hired teachers to a school reflects district decision makers' preferences regarding the relative importance of meeting preferred staffing ratios at schools serving different student populations. In either case, the important question from the perspective of this analysis is the degree to which either teachers' or districts' preferences affect the distribution of teachers among schools serving diverse student populations.

Our data describe the numbers and qualifications of the teachers employed in each school in each district in our sample. Our data do not indicate the number of vacant positions by school. However, in the empirical work reported below, we examine the relationship between the teacher/pupil ratio report for each school and the district-wide teacher/pupil ratio to determine the extent to which the implicit distribution of vacancies is related to pupil characteristics. We also examine the process that affect the distributions of credentialed teachers and of underqualified teachers among the schools. In each case, our

¹⁹ Teachers who take on additional responsibilities—coaching an athletic team, assisting the principal, etc.—may earn additional pay. While the amounts provided for these responsibilities are generally independent of the specific school in which the teacher is employed, a teacher's choice among schools may be affected by the availability of such positions.

primary concern is the extent to which, controlling for other factors, the characteristics of a school or of its students affect the flows of teachers into and out of the school in a way that influences the quality of its teaching force.

THE SUPPLY OF TEACHERS FROM INSIDE THE DISTRICT

The Supply of Returning Teachers

We earlier examined the factors that affect teachers' decisions to return to a district. A teacher who decides to return to a district may return to the same school that he or she had been in the previous year. Or, he or she might seek a transfer to another school. As noted earlier, the odds that a teacher will leave the district are significantly positively related to the percent Black in the teacher's school. Other things equal, schools serving disproportionate numbers of Black students will have relatively fewer returning teachers and, thus, will have to recruit relatively many teachers from other schools in the district or from outside the district.

The Supply of Transferring Teachers

Enrollment growth and teacher exits from schools create vacancies throughout a district. The teachers employed in the district the prior year have the right to transfer from their school to another school in the district in which there is a vacancy. Intradistrict transfers reflect teachers' choices; schools that offer relatively more attractive working conditions will have greater success in filling vacancies through the transfer of teachers within the district. Accordingly, if the characteristics of a school's pupil population affect teachers' perceptions of the working conditions in the school, the distribution of teachers among the schools in a district will reflect the distribution of pupil characteristics among those schools.

Our data allow us to identify those teachers who were employed in each district in 1995 and in 1996 who had been employed in that district the prior year. We used these data to explore the factors that affected the relative attractiveness of a school to the teachers who remained in a district from one year to the next. Specifically, for the subset of teachers who remained in the same district in 1995 or in 1996, we defined an indicator variable which had the value zero if a teacher returned to the school in which he or she taught the prior year and one if the teacher transferred to another school in the same district. We regress this indicator on measures of the factors that might influence a teacher's decision to transfer to another school. We perform separate regressions for the transition from 1994 to 1995 and for the transition from 1995 to 1996. A teacher's working conditions and, hence, his or her decision to transfer might vary by the grade level of his or her assignment. Accordingly, we performed separate analyses for each year for all teachers in the sample combined and for five separate groups of teachers divided by the grade level of their teaching assignment.

We assume a teacher's decision to transfer within a district is influenced by characteristics of the county in which the district is located, district characteristics, the characteristics of the students in the school in which the teacher taught in the initial year, and by the characteristics of the students in a school to which the teacher has an opportunity to transfer. A teacher's salary prospects influences his or her decision to leave the district. Because teachers in districts offering high maximum salaries might choose to transfer rather than leave a district, we enter the maximum salary in a teacher's district as a rough measure of the teacher's salary prospects. We also include measures of the size of the teacher's class each year and his or her characteristics.

Preliminary analyses suggested that the effects of some of the independent variables was nonlinear. To control for nonlinearities, we included those independent variables both linearly and squared or cubed.

The results of logistic regressions of the indicator on the independent variables for the transition from 1994 to 1995 are presented in Table 5.1. Table 5.2 presents the corresponding results for the transition from 1995 to 1996. Because of multicollinearity, the indicator for schools located in rural areas had to be omitted from some of the regressions. The standard errors and z-scores reported in Tables 5.1 and 5.2 have been adjusted to reflect the clustering of observations by school.

Our primary concern is for the effects of students' characteristics on returning teachers' decisions to either remain in a school or transfer to another school within the district. The results in this respect are dramatic. The relationship between the proportion of a school's students who are Black or Hispanic and the likelihood that a teacher in that school will transfer to another school is clear. The odds that a teacher will transfer out of a school are significantly positively related to both the percent Black and the percent Hispanic in the school for all teachers combined and for the teachers in each of the five separate grade level groups in both of the transition years included in our data. The odds that a teacher will transfer into a school are significantly negatively related to both the percent Black and the percent Hispanic in the school. Here, too, the result holds for all teachers combined and for the teachers in each of the five separate grade level groups in both transition years included in our data. The magnitudes of these effects vary between years and grade levels. But there is a consistent pattern: Teachers tend to transfer out of schools having relatively high minority pupil populations and into schools having relatively low populations of minority pupils.

We see the same general pattern with respect to the percent of the students in a school who are eligible for free lunch. Teachers tend to transfer out of schools with high proportions of students from poor families and into schools with relatively low proportions of poor students.

The likelihood that a teacher will transfer from one school within a district to another also depends on the teacher's experience. The effect of experience is particularly pronounced

for new teachers with no prior experience. New teachers with no prior experience are disproportionately likely to transfer after their first year of teaching.

The size of a teacher's class did not have a strong effect on the decision to transfer.

Table 5.1a

**Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Transfer:
All Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|----------|----------|-----------|---------------|---------------|---------|
| Dependent variable/Constant | 0.04 | 0.20 | -6.47E+00 | | 1.28 | -5.06 |
| County characteristics | | | | | | |
| Population density | 1344.00 | 2291.33 | -9.42E-05 | 1.00 | 0.00 | -3.96 |
| Unemployment rate | 9.05 | 3.41 | 5.08E-03 | 1.01 | 0.02 | 0.28 |
| Per capita income | 22302.23 | 4736.26 | 1.31E-05 | 1.00 | 0.00 | 1.12 |
| Ave. wage | 27873.74 | 4907.80 | -1.04E-05 | 1.00 | 0.00 | -0.79 |
| Federal wage | 37777.88 | 4623.76 | 1.09E-05 | 1.00 | 0.00 | 1.21 |
| District characteristics | | | | | | |
| No. schools in district | 22.75 | 21.78 | -3.11E-02 | 0.97 | 0.01 | -4.02 |
| No. schools in district t cubed | 65204.55 | 2.04E+05 | 2.27E-06 | 1.00 | 0.00 | 4.50 |
| No. Pupils in district | 17265.48 | 15950.45 | 2.91E-05 | 1.00 | 0.00 | 2.97 |
| No. pupils in district cubed | 2.51E+13 | 7.33E+13 | -2.05E-15 | 1.00 | 0.00 | -2.45 |
| Rate of enrollment growth | 0.93 | 2.15 | -4.06E-02 | 0.96 | 0.02 | -2.50 |
| Maximum teachers' salary | 51026.61 | 4088.70 | 2.91E-05 | 1.00 | 0.00 | 3.29 |
| Inst. exp. /pupil | 1816.52 | 172.84 | -7.88E-04 | 1.00 | 0.00 | -4.04 |
| Adm. exp./pupil | 177.74 | 43.24 | 1.54E-05 | 1.00 | 0.00 | 3.01 |
| Pct students nonwhite in district | 0.52 | 0.25 | 1.18E-01 | 1.13 | 0.26 | 0.51 |
| From (1994) school characteristics | | | | | | |
| No. pupils in school | 1033.24 | 695.02 | 2.15E-03 | 1.00 | 0.00 | 3.90 |
| No. pupils in school cubed | 3.16E+09 | 8.08E+09 | -4.93E-11 | 1.00 | 0.00 | -1.08 |
| Pct. students Black | 6.61 | 9.56 | 8.04E-02 | 1.08 | 0.02 | 4.57 |
| Pct. students Hispanic | 32.46 | 25.53 | 7.06E-02 | 1.07 | 0.01 | 7.27 |
| Pct. students Asian | 10.62 | 13.01 | -9.98E-03 | 0.99 | 0.02 | -0.54 |
| Pct. students Am Indian | 0.62 | 2.49 | 6.36E-02 | 1.07 | 0.04 | 1.56 |
| Pct. students Free lunch eligible | 39.32 | 26.96 | 3.55E-02 | 1.04 | 0.00 | 8.83 |
| Class size | 30.66 | 12.15 | -1.30E-03 | 1.00 | 0.00 | -0.68 |
| Urban | 0.30 | 0.46 | 4.06E-01 | 1.50 | 0.40 | 1.52 |
| To (1995) school characteristics | | | | | | |
| No. Pupils in school | 1048.02 | 708.35 | -2.55E-03 | 1.00 | 0.00 | -4.69 |
| No. pupils in school cubed | 3.33E+09 | 8.60E+09 | 5.68E-11 | 1.00 | 0.00 | 1.29 |
| Pct. students Black | 6.71 | 9.59 | -7.57E-02 | 0.93 | 0.02 | -4.25 |
| Pct. students Hispanic | 33.31 | 25.83 | -8.17E-02 | 0.92 | 0.01 | -8.16 |
| Pct. students Asian | 10.72 | 13.23 | 9.32E-04 | 1.00 | 0.02 | 0.05 |
| Pct. students Am Indian | 0.64 | 2.58 | -8.27E-02 | 0.92 | 0.04 | -1.83 |
| Pct. students Free lunch eligible | 40.70 | 27.35 | -2.92E-02 | 0.97 | 0.00 | -7.46 |
| Class size | 31.05 | 13.59 | 2.04E-03 | 1.00 | 0.00 | 1.58 |
| Urban | 0.29 | 0.45 | -3.19E-01 | 0.73 | 0.20 | -1.17 |
| Teacher characteristics | | | | | | |
| Female | 0.70 | 0.46 | -5.21E-02 | 0.95 | 0.04 | -1.27 |
| No prior experience | 0.05 | 0.21 | 3.82E-01 | 1.47 | 0.10 | 5.48 |
| 1 - 3 yrs experience | 0.13 | 0.34 | 1.21E-01 | 1.13 | 0.06 | 2.18 |
| Total experience | 14.87 | 9.78 | -3.12E-02 | 0.97 | 0.00 | -9.58 |
| Age | 43.25 | 9.65 | 2.66E-01 | 1.30 | 0.10 | 3.45 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|----------|----------|-----------|---------------|---------------|---------|
| Age squared | 1,963.4 | 827.2 | -5.74E-03 | 0.99 | 0.00 | -3.09 |
| Age cubed | 92,830.5 | 5.61E+04 | 3.77E-05 | 1.00 | 0.00 | 2.59 |
| Education, BA or less | 0.09 | 0.29 | 3.82E-02 | 1.04 | 0.06 | 0.65 |
| Education, MA or more | 0.32 | 0.47 | 1.47E-01 | 1.16 | 0.05 | 3.78 |
| Black | 0.03 | 0.18 | 1.52E-01 | 1.16 | 0.12 | 1.52 |
| Hispanic | 0.09 | 0.28 | 2.85E-02 | 1.03 | 0.06 | 0.46 |
| Asian | 0.04 | 0.19 | -5.47E-02 | 0.95 | 0.08 | -0.61 |
| Am. Indian | 0.01 | 0.09 | 1.88E-02 | 1.02 | 0.18 | 0.11 |
| Number of ob | | | 106,782 | | | |
| Chi2 | | | 1,248.36 | | | |
| Prob > chi2 | | | 0 | | | |

Table 5.1b
Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Transfer:
K-2 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.0443054 | 0.205776 | 0.49 | | 0.38 | 1.29 |
| County characteristics | | | | | | |
| Population density | 1317.572 | 2155.723 | -6.43E-05 | 1.00 | 0.00 | -1.75 |
| Unemployment rate | 9.047212 | 3.37687 | -3.02E-02 | 0.97 | 0.02 | -1.64 |
| Per capita income | 22243.11 | 4667.82 | -9.12E-07 | 1.00 | 0.00 | -0.06 |
| Ave. wage | 27840.63 | 4823.732 | -2.09E-05 | 1.00 | 0.00 | -1.22 |
| Federal wage | 37746.07 | 4575.794 | 1.83E-05 | 1.00 | 0.00 | 1.60 |
| District characteristics | | | | | | |
| No. schools in district | 23.13946 | 21.42224 | -1.03E-02 | 0.99 | 0.01 | -0.79 |
| No. schools in district cubed | 63427.95 | 193979.4 | 1.13E-06 | 1.00 | 0.00 | 1.31 |
| No. Pupils in district | 17051.61 | 16055.34 | -4.46E-06 | 1.00 | 0.00 | -0.27 |
| No. pupils in district cubed | 2.51E+13 | 7.38E+13 | 3.96E-16 | 1.00 | 0.00 | 0.29 |
| Rate of enrollment growth | 0.8735984 | 2.130934 | -1.38E-02 | 0.99 | 0.02 | -0.67 |
| Maximum teachers' salary | 50959.8 | 4129.09 | 1.08E-06 | 1.00 | 0.00 | 0.08 |
| Inst. exp. /pupil | 1798.616 | 160.1569 | -5.20E-04 | 1.00 | 0.00 | -1.99 |
| Adm. exp./pupil | 141.589 | 48.947 | 3.49E-05 | 1.00 | 0.00 | 2.44 |
| Pct students nonwhite in district | 0.534506 | 0.254577 | -2.57E-01 | 0.77 | 0.24 | -0.81 |
| From (1994) school characteristics | | | | | | |
| No. Pupils in school | 659.2832 | 220.3411 | 5.37E-03 | 1.01 | 0.00 | 3.21 |
| No. pupils in school cubed | 3.88E+08 | 4.36E+08 | -1.59E-09 | 1.00 | 0.00 | -2.54 |
| Pct. students Black | 6.747301 | 9.868029 | 9.86E-02 | 1.10 | 0.03 | 4.01 |
| Pct. students Hispanic | 34.97321 | 27.23923 | 6.30E-02 | 1.07 | 0.01 | 4.72 |
| Pct. students Asian | 9.728769 | 12.5547 | 1.43E-02 | 1.01 | 0.02 | 0.64 |
| Pct. students Am Indian | 0.5847955 | 2.707791 | 3.24E-02 | 1.03 | 0.03 | 1.08 |
| Pct. students Free lunch eligible | 48.28203 | 28.38081 | 3.44E-02 | 1.03 | 0.01 | 6.26 |
| Class size | 29.18558 | 5.906692 | -1.05E-02 | 0.99 | 0.01 | -1.08 |
| Urban | 0.3083731 | 0.461828 | 2.24E-01 | 1.25 | 0.57 | 0.50 |
| To (1995) school characteristics | | | | | | |
| No. Pupils in school | 668.3936 | 226.2284 | -5.22E-03 | 0.99 | 0.00 | -3.54 |
| No. pupils in school cubed | 4.09E+08 | 4.89E+08 | 1.64E-09 | 1.00 | 0.00 | 3.26 |
| Pct. students Black | 6.901682 | 9.947167 | -8.36E-02 | 0.92 | 0.02 | -3.35 |
| Pct. students Hispanic | 35.99826 | 27.54558 | -6.67E-02 | 0.94 | 0.01 | -4.90 |
| Pct. students Asian | 9.69116 | 12.7302 | -1.51E-02 | 0.99 | 0.02 | -0.70 |
| Pct. students Am Indian | 0.611088 | 2.774451 | -1.89E-02 | 0.98 | 0.03 | -0.55 |
| Pct. students Free lunch eligible | 49.59077 | 28.726 | -3.49E-02 | 0.97 | 0.01 | -6.41 |
| Class size | 29.25846 | 5.596642 | 2.95E-03 | 1.00 | 0.01 | 0.56 |
| Urban | 0.2953696 | 0.456215 | -3.89E-02 | 0.96 | 0.45 | -0.08 |
| Teacher characteristics | | | | | | |
| Female | 0.9247041 | 0.263872 | -2.69E-01 | 0.76 | 0.07 | -3.06 |
| No prior experience | 0.0458627 | 0.20919 | 4.92E-01 | 1.64 | 0.18 | 4.39 |
| 1 - 3 yrs experience | 0.1313331 | 0.337769 | 7.41E-02 | 1.08 | 0.10 | 0.81 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|----------|-----------|---------------|---------------|---------|
| Total experience | 14.16977 | 9.538126 | -2.11E-02 | 0.98 | 0.01 | -4.05 |
| Age | 42.81639 | 9.860363 | 2.55E-01 | 1.29 | 0.16 | 2.10 |
| Age squared | 1930.468 | 842.5585 | -5.83E-03 | 0.99 | 0.00 | -2.01 |
| Age cubed | 90895.47 | 57033.05 | 3.91E-05 | 1.00 | 0.00 | 1.73 |
| Education, BA or less | 0.1052481 | 0.306877 | -4.03E-02 | 0.96 | 0.09 | -0.46 |
| Education, MA or more | 0.2498962 | 0.432958 | 7.03E-02 | 1.07 | 0.07 | 1.09 |
| Black | 0.0296927 | 0.16974 | 3.78E-01 | 1.46 | 0.23 | 2.41 |
| Hispanic | 0.1072467 | 0.309431 | 7.38E-02 | 1.08 | 0.10 | 0.80 |
| Asian | 0.0477834 | 0.213311 | -2.00E-01 | 0.82 | 0.11 | -1.53 |
| Am. Indian | 0.0060995 | 0.077862 | 3.45E-01 | 1.41 | 0.38 | 1.29 |
| Number of ob | | | 38,899 | | | |
| Chi2 | | | 607.9 | | | |
| Prob > chi2 | | | 0 | | | |

Table 5.1c
Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Transfer:
Grades 4-6 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.06 | 0.23 | 0.50 | | 0.24 | -1.46 |
| County characteristics | | | | | | |
| Population density | 1,245.56 | 2,054.98 | -1.01E-04 | 1.00 | 0.00 | -2.44 |
| Unemployment rate | 9.22 | 3.53 | -1.43E-03 | 1.00 | 0.02 | -0.07 |
| Per capita income | 21,990.48 | 4,581.54 | 1.15E-05 | 1.00 | 0.00 | 0.65 |
| Ave. wage | 27,615.44 | 4,845.87 | -3.62E-06 | 1.00 | 0.00 | -0.18 |
| Federal wage | 37,561.07 | 4,704.25 | 2.79E-05 | 1.00 | 0.00 | 2.20 |
| District characteristics | | | | | | |
| No. schools in district | 22.28 | 20.64 | -5.25E-04 | 1.00 | 0.02 | -0.03 |
| No. schools in district cubed | 57,445.44 | 1.84E+05 | 1.47E-06 | 1.00 | 0.00 | 1.46 |
| No. Pupils in district | 16,304.17 | 15,252.50 | -1.84E-05 | 1.00 | 0.00 | -0.88 |
| No. pupils in district cubed | 2.18E+13 | 6.67E+13 | 1.42E-15 | 1.00 | 0.00 | 0.82 |
| Rate of enrollment growth | 0.90 | 2.15 | -1.98E-02 | 0.98 | 0.03 | -0.66 |
| Maximum teachers' salary | 50,894.96 | 4,157.35 | 3.98E-06 | 1.00 | 0.00 | 0.28 |
| Inst. exp. /pupil | 1,796.33 | 155.97 | -3.83E-04 | 1.00 | 0.00 | -1.14 |
| Adm. exp./pupil | 161.34 | 57.82 | 4.48E-06 | 1.00 | 0.00 | 0.28 |
| Pct students nonwhite in district | 0.52 | 0.25 | -1.40E-01 | 0.87 | 0.33 | -0.37 |
| From (1994) school characteristics | | | | | | |
| No. Pupils in school | 672.75 | 224.90 | 5.71E-03 | 1.01 | 0.00 | 2.79 |
| No. pupils in school cubed | 4.17E+08 | 5.26E+08 | -3.10E-09 | 1.00 | 0.00 | -3.69 |
| Pct. students Black | 6.39 | 9.52 | 5.32E-02 | 1.05 | 0.03 | 2.04 |
| Pct. students Hispanic | 33.47 | 26.55 | 5.65E-02 | 1.06 | 0.02 | 3.92 |
| Pct. students Asian | 9.65 | 12.44 | -1.25E-02 | 0.99 | 0.03 | -0.49 |
| Pct. students Am Indian | 0.60 | 2.63 | 1.25E-01 | 1.13 | 0.08 | 1.76 |
| Pct. students Free lunch eligible | 46.09 | 27.84 | 3.81E-02 | 1.04 | 0.01 | 5.79 |
| Class size | 29.87 | 5.66 | -1.81E-02 | 0.98 | 0.01 | -1.92 |
| Urban | 0.30 | 0.46 | 4.98E-02 | 1.05 | 0.41 | 0.13 |
| To (1995) school characteristics | | | | | | |
| No. Pupils in school | 682.62 | 235.12 | -4.99E-03 | 1.00 | 0.00 | -2.82 |
| No. pupils in school cubed | 4.44E+08 | 6.17E+08 | 2.78E-09 | 1.00 | 0.00 | 4.20 |
| Pct. students Black | 6.55 | 9.63 | -4.57E-02 | 0.96 | 0.02 | -1.76 |
| Pct. students Hispanic | 34.40 | 26.85 | -6.54E-02 | 0.94 | 0.01 | -4.43 |
| Pct. students Asian | 9.67 | 12.69 | 5.10E-03 | 1.01 | 0.02 | 0.21 |
| Pct. students Am Indian | 0.64 | 2.81 | -1.20E-01 | 0.89 | 0.06 | -1.68 |
| Pct. students Free lunch eligible | 47.36 | 28.07 | -3.36E-02 | 0.97 | 0.01 | -5.06 |
| Class size | 29.88 | 5.66 | 6.21E-04 | 1.00 | 0.01 | 0.11 |
| Urban | 0.29 | 0.45 | -3.82E-02 | 0.96 | 0.39 | -0.10 |
| Teacher characteristics | | | | | | |
| Female | 0.76 | 0.42 | -3.18E-02 | 0.97 | 0.07 | -0.42 |
| No prior experience | 0.05 | 0.22 | 2.47E-01 | 1.28 | 0.18 | 1.75 |
| 1 - 3 yrs experience | 0.14 | 0.35 | 1.93E-01 | 1.21 | 0.13 | 1.78 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|------------|------------|---------|
| Total experience | 13.75 | 9.54 | -3.07E-02 | 0.97 | 0.01 | -4.93 |
| Age | 42.62 | 9.59 | 3.01E-01 | 1.35 | 0.22 | 1.86 |
| Age squared | 1,908.24 | 815.61 | -6.24E-03 | 0.99 | 0.00 | -1.58 |
| Age cubed | 89,081.89 | 54,934.26 | 4.03E-05 | 1.00 | 0.00 | 1.30 |
| Education, BA or less | 0.10 | 0.30 | 1.17E-01 | 1.12 | 0.13 | 1.04 |
| Education, MA or more | 0.28 | 0.45 | 1.78E-01 | 1.19 | 0.10 | 2.15 |
| Black | 0.03 | 0.18 | 1.16E-01 | 1.12 | 0.19 | 0.68 |
| Hispanic | 0.08 | 0.27 | 8.77E-02 | 1.09 | 0.13 | 0.71 |
| Asian | 0.03 | 0.18 | -9.80E-02 | 0.91 | 0.17 | -0.53 |
| Am. Indian | 0.01 | 0.08 | -6.94E-01 | 0.50 | 0.24 | -1.46 |
| Number of ob | | | 20,129 | | | |
| Chi2 | | | 366.78 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.1d
Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Transfer:
Grades 6-8 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.05 | 0.23 | -7.10 | | 2.94 | -2.406 |
| County characteristics | | | | | | |
| Population density | 1,406.85 | 2,519.54 | -4.53E-05 | 1.00 | 0.00 | -0.71 |
| Unemployment rate | 9.02 | 3.36 | -5.11E-02 | 0.95 | 0.03 | -1.57 |
| Per capita income | 22,448.64 | 4,868.47 | -1.32E-05 | 1.00 | 0.00 | -0.53 |
| Ave. wage | 27,951.32 | 4,914.08 | -4.71E-06 | 1.00 | 0.00 | -0.13 |
| Federal wage | 37,885.36 | 4,571.14 | -4.32E-05 | 1.00 | 0.00 | -2.03 |
| District characteristics | | | | | | |
| No. schools in district | 23.25 | 22.47 | 3.25E-03 | 1.00 | 0.02 | 0.16 |
| No. schools in district cubed | 71,445.90 | 2.23E+05 | 7.53E-07 | 1.00 | 0.00 | 0.59 |
| No. Pupils in district | 17,568.77 | 16,673.09 | -2.39E-05 | 1.00 | 0.00 | -0.89 |
| No. pupils in district cubed | 2.79E+13 | 8.03E+13 | 5.56E-16 | 1.00 | 0.00 | 0.25 |
| Rate of enrollment growth | 0.89 | 2.14 | -8.53E-02 | 0.92 | 0.04 | -1.81 |
| Maximum teachers' salary | 50,959.79 | 4,027.90 | 4.70E-05 | 1.00 | 0.00 | 1.89 |
| Inst. exp. /pupil | 1,809.66 | 161.95 | -4.71E-04 | 1.00 | 0.00 | -1.05 |
| Adm. exp./pupil | 175.10 | 23.20 | 3.87E-05 | 1.00 | 0.00 | 0.98 |
| Pct students nonwhite in district | 0.52 | 0.25 | 6.26E-01 | 1.87 | 1.43 | 0.82 |
| From (1994) school characteristics | | | | | | |
| No. Pupils in school | 959.11 | 401.56 | 7.95E-03 | 1.01 | 0.00 | 4.92 |
| No. pupils in school cubed | 1.48E+09 | 4.13E+09 | -1.39E-09 | 1.00 | 0.00 | -4.41 |
| Pct. students Black | 6.66 | 9.23 | 4.21E-02 | 1.04 | 0.05 | 0.91 |
| Pct. students Hispanic | 31.17 | 24.20 | 8.60E-02 | 1.09 | 0.03 | 3.50 |
| Pct. students Asian | 11.48 | 13.25 | -7.13E-02 | 0.93 | 0.04 | -1.49 |
| Pct. students Am Indian | 0.59 | 2.27 | -4.06E-02 | 0.96 | 0.19 | -0.20 |
| Pct. students Free lunch eligible | 38.69 | 24.00 | 3.70E-02 | 1.04 | 0.01 | 4.07 |
| Class size | 33.20 | 18.91 | 2.94E-03 | 1.00 | 0.00 | 1.14 |
| Urban | 0.30 | 0.46 | 5.62E-01 | 1.75 | 0.74 | 1.33 |
| To (1995) school characteristics | | | | | | |
| No. Pupils in school | 963.85 | 424.07 | -7.06E-03 | 0.99 | 0.00 | -4.64 |
| No. pupils in school cubed | 1.61E+09 | 5.08E+09 | 1.24E-09 | 1.00 | 0.00 | 4.58 |
| Pct. students Black | 6.74 | 9.27 | -4.72E-02 | 0.95 | 0.05 | -0.98 |
| Pct. students Hispanic | 31.96 | 24.52 | -9.96E-02 | 0.91 | 0.02 | -3.74 |
| Pct. students Asian | 11.70 | 13.55 | 4.74E-02 | 1.05 | 0.05 | 1.03 |
| Pct. students Am Indian | 0.58 | 2.37 | -5.59E-02 | 0.95 | 0.21 | -0.25 |
| Pct. students Free lunch eligible | 40.02 | 24.82 | -2.91E-02 | 0.97 | 0.01 | -3.15 |
| Class size | 34.11 | 22.06 | -3.01E-03 | 1.00 | 0.00 | -1.09 |
| Urban | 0.30 | 0.46 | -6.47E-01 | 0.52 | 0.23 | -1.48 |
| Teacher characteristics | | | | | | |
| Female | 0.59 | 0.49 | -4.92E-02 | 0.95 | 0.06 | -0.73 |
| No prior experience | 0.05 | 0.22 | 2.23E-01 | 1.25 | 0.20 | 1.41 |
| 1 - 3 yrs experience | 0.14 | 0.35 | 3.96E-01 | 1.49 | 0.19 | 3.10 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Total experience | 14.60 | 9.83 | -2.19E-02 | 0.98 | 0.01 | -3.31 |
| Age | 43.11 | 9.49 | 3.19E-01 | 1.38 | 0.25 | 1.73 |
| Age squared | 1,948.60 | 811.02 | -6.44E-03 | 0.99 | 0.00 | -1.47 |
| Age cubed | 91,641.99 | 54,746.08 | 3.96E-05 | 1.00 | 0.00 | 1.17 |
| Education, BA or less | 0.09 | 0.28 | 1.69E-02 | 1.02 | 0.13 | 0.13 |
| Education, MA or more | 0.34 | 0.47 | 1.19E-01 | 1.13 | 0.11 | 1.19 |
| Black | 0.04 | 0.20 | -2.45E-02 | 0.98 | 0.22 | -0.11 |
| Hispanic | 0.06 | 0.24 | 5.83E-02 | 1.06 | 0.15 | 0.41 |
| Asian | 0.03 | 0.18 | 9.60E-02 | 1.10 | 0.21 | 0.51 |
| Am. Indian | 0.01 | 0.09 | 7.83E-02 | 1.08 | 0.43 | 0.20 |
| Number of ob | | | 18,636.0 | | | |
| Chi2 | | | 364.01 | | | |
| Prob > chi2 | | | 0.0 | | | |

Table 5.1e
Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Transfer:
Grades 9-12 Math Science Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.02 | 0.15 | -7.87 | | 5.67 | -1.39 |
| County characteristics | | | | | | |
| Population density | 1,448.13 | 2,523.54 | -1.74E-04 | 1.00 | 0.00 | -1.81 |
| Unemployment rate | 8.85 | 3.30 | 1.19E-01 | 1.13 | 0.05 | 2.56 |
| Per capita income | 22,619.54 | 4,838.21 | 6.99E-05 | 1.00 | 0.00 | 1.69 |
| Ave. wage | 28,185.69 | 5,031.27 | 1.83E-05 | 1.00 | 0.00 | 0.36 |
| Federal wage | 38,012.36 | 4,605.63 | -5.95E-05 | 1.00 | 0.00 | -1.62 |
| District characteristics | | | | | | |
| No. schools in district | 22.73 | 22.88 | -1.16E-01 | 0.89 | 0.02 | -4.75 |
| No. schools in district cubed | 72,100.23 | 2.24E+05 | 5.54E-06 | 1.00 | 0.00 | 2.91 |
| No. Pupils in district | 18,422.99 | 15,934.14 | 1.69E-04 | 1.00 | 0.00 | 5.37 |
| No. pupils in district cubed | 2.67E+13 | 7.40E+13 | -1.02E-14 | 1.00 | 0.00 | -3.15 |
| Rate of enrollment growth | 1.03 | 2.18 | -4.53E-03 | 1.00 | 0.05 | -0.09 |
| Maximum teachers' salary | 51,364.94 | 3,999.43 | 1.04E-04 | 1.00 | 0.00 | 2.81 |
| Inst. exp. /pupil | 1,860.98 | 196.72 | -1.54E-03 | 1.00 | 0.00 | -2.52 |
| Adm. exp./pupil | 177.42 | 50.39 | -8.03E-06 | 1.00 | 0.00 | -0.24 |
| Pct students nonwhite in district | 0.51 | 0.24 | 1.29E+00 | 3.63 | 3.78 | 1.24 |
| From (1994) school characteristics | | | | | | |
| No. Pupils in school | 1,852.89 | 805.56 | 3.87E-03 | 1.00 | 0.00 | 3.83 |
| No. pupils in school cubed | 1.01E+10 | 1.32E+10 | -4.78E-11 | 1.00 | 0.00 | -0.90 |
| Pct. students Black | 6.69 | 9.48 | 2.43E-01 | 1.27 | 0.10 | 3.08 |
| Pct. students Hispanic | 28.82 | 22.51 | 1.09E-01 | 1.12 | 0.05 | 2.54 |
| Pct. students Asian | 12.30 | 13.86 | -5.53E-02 | 0.95 | 0.08 | -0.67 |
| Pct. students Am Indian | 0.70 | 2.27 | 4.23E-01 | 1.53 | 0.21 | 3.04 |
| Pct. students Free lunch eligible | 22.74 | 16.59 | -1.98E-03 | 1.00 | 0.02 | -0.10 |
| Class size | 31.26 | 12.87 | -6.25E-03 | 0.99 | 0.01 | -0.64 |
| Urban | 0.29 | 0.46 | -1.07E+00 | 0.34 | 0.40 | -0.93 |
| To (1995) school characteristics | | | | | | |
| No. Pupils in school | 1,883.77 | 812.19 | -4.32E-03 | 1.00 | 0.00 | -3.65 |
| No. pupils in school cubed | 1.06E+10 | 1.39E+10 | -5.96E-11 | 1.00 | 0.00 | -0.64 |
| Pct. students Black | 6.68 | 9.32 | -2.52E-01 | 0.78 | 0.07 | -2.94 |
| Pct. students Hispanic | 29.41 | 22.72 | -1.52E-01 | 0.86 | 0.04 | -3.53 |
| Pct. students Asian | 12.56 | 14.07 | 3.88E-02 | 1.04 | 0.08 | 0.50 |
| Pct. students Am Indian | 0.72 | 2.32 | -5.89E-01 | 0.55 | 0.10 | -3.42 |
| Pct. students Free lunch eligible | 24.24 | 17.33 | 1.53E-02 | 1.02 | 0.02 | 0.87 |
| Class size | 31.68 | 13.51 | 1.33E-02 | 1.01 | 0.01 | 2.30 |
| Urban | 0.29 | 0.45 | 8.35E-01 | 2.31 | 2.78 | 0.69 |
| Teacher characteristics | | | | | | |
| Female | 0.34 | 0.47 | 2.43E-01 | 1.27 | 0.25 | 1.24 |
| No prior experience | 0.04 | 0.20 | 1.39E+00 | 4.01 | 1.56 | 3.58 |
| 1 - 3 yrs experience | 0.13 | 0.33 | -1.94E-01 | 0.82 | 0.30 | -0.53 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Total experience | 15.68 | 10.00 | -4.93E-02 | 0.95 | 0.02 | -2.87 |
| Age | 43.25 | 9.60 | 9.87E-02 | 1.10 | 0.45 | 0.24 |
| Age squared | 1,962.38 | 822.92 | -1.38E-03 | 1.00 | 0.01 | -0.14 |
| Age cubed | 92,704.30 | 55,668.84 | 2.86E-06 | 1.00 | 0.00 | 0.04 |
| Education, BA or less | 0.07 | 0.26 | 2.72E-01 | 1.31 | 0.39 | 0.91 |
| Education, MA or more | 0.44 | 0.50 | 5.25E-01 | 1.69 | 0.35 | 2.56 |
| Black | 0.03 | 0.16 | 4.57E-01 | 1.58 | 0.84 | 0.87 |
| Hispanic | 0.06 | 0.24 | 1.59E-01 | 1.17 | 0.45 | 0.41 |
| Asian | 0.05 | 0.21 | 4.60E-01 | 1.58 | 0.53 | 1.38 |
| Am. Indian | 0.01 | 0.10 | 9.81E-01 | 2.67 | 1.73 | 1.52 |
| Number of ob | | | 7,981 | | | |
| Chi2 | | | 283.84 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.1f
Logistic Regression Results: Odds That Teachers
Employed in 1994 Will Transfer:
Grades 9-12 Other Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.02 | 0.13 | -8.90 | | 3.95 | -2.26 |
| County characteristics | | | | | | |
| Population density | 1,392.55 | 2,437.35 | -1.26E-04 | 1.00 | 0.00 | -1.62 |
| Unemployment rate | 9.00 | 3.44 | 1.20E-01 | 1.13 | 0.04 | 3.26 |
| Per capita income | 22,461.59 | 4,830.98 | 6.50E-05 | 1.00 | 0.00 | 2.02 |
| Ave. wage | 27,996.51 | 5,053.99 | 5.06E-05 | 1.00 | 0.00 | 1.41 |
| Federal wage | 37,861.30 | 4,678.10 | -3.66E-05 | 1.00 | 0.00 | -1.48 |
| District characteristics | | | | | | |
| No. schools in district | 22.07 | 22.43 | -8.19E-02 | 0.92 | 0.02 | -4.98 |
| No. schools in district cubed | 67,822.74 | 2.16E+05 | 2.66E-06 | 1.00 | 0.00 | 1.69 |
| No. Pupils in district | 17,878.49 | 15,703.61 | 1.21E-04 | 1.00 | 0.00 | 5.45 |
| No. pupils in district cubed | 2.51E+13 | 7.14E+13 | -7.84E-15 | 1.00 | 0.00 | -3.26 |
| Rate of enrollment growth | 1.05 | 2.18 | -1.02E-01 | 0.90 | 0.04 | -2.44 |
| Maximum teachers' salary | 51,207.71 | 4,020.82 | 1.93E-05 | 1.00 | 0.00 | 0.83 |
| Inst. exp. /pupil | 1,858.28 | 198.43 | -1.10E-03 | 1.00 | 0.00 | -2.19 |
| Adm. exp./pupil | 179.81 | 31.87 | 2.37E-05 | 1.00 | 0.00 | 2.70 |
| Pct students nonwhite in district | 0.51 | 0.24 | 3.88E-01 | 1.47 | 1.01 | 0.56 |
| From (1994) school characteristics | | | | | | |
| No. Pupils in school | 1,826.62 | 807.25 | 4.43E-03 | 1.00 | 0.00 | 5.18 |
| No. pupils in school cubed | 9.79E+09 | 1.28E+10 | -8.97E-11 | 1.00 | 0.00 | -2.18 |
| Pct. students Black | 6.50 | 9.34 | 1.45E-01 | 1.16 | 0.08 | 2.07 |
| Pct. students Hispanic | 29.36 | 22.78 | 6.77E-02 | 1.07 | 0.02 | 3.31 |
| Pct. students Asian | 11.83 | 13.58 | -8.17E-02 | 0.92 | 0.06 | -1.19 |
| Pct. students Am Indian | 0.72 | 2.18 | -2.18E-02 | 0.98 | 0.13 | -0.17 |
| Pct. students Free lunch eligible | 23.08 | 16.67 | 3.31E-03 | 1.00 | 0.01 | 0.26 |
| Class size | 31.69 | 16.22 | -3.91E-03 | 1.00 | 0.01 | -0.69 |
| Urban | 0.30 | 0.46 | 1.88E+00 | 6.54 | 5.44 | 2.26 |
| To (1995) school characteristics | | | | | | |
| No. Pupils in school | 1,859.39 | 815.46 | -5.15E-03 | 0.99 | 0.00 | -6.06 |
| No. pupils in school cubed | 1.03E+10 | 1.35E+10 | 8.87E-11 | 1.00 | 0.00 | 1.90 |
| Pct. students Black | 6.52 | 9.25 | -1.59E-01 | 0.85 | 0.06 | -2.13 |
| Pct. students Hispanic | 29.97 | 23.01 | -9.19E-02 | 0.91 | 0.02 | -4.10 |
| Pct. students Asian | 12.07 | 13.78 | 7.62E-02 | 1.08 | 0.07 | 1.12 |
| Pct. students Am Indian | 0.74 | 2.24 | -1.56E-01 | 0.86 | 0.12 | -1.14 |
| Pct. students Free lunch eligible | 24.69 | 17.50 | 8.13E-03 | 1.01 | 0.01 | 0.78 |
| Class size | 32.56 | 18.19 | 1.24E-02 | 1.01 | 0.00 | 4.05 |
| Urban | 0.29 | 0.45 | -1.53E+00 | 0.22 | 0.19 | -1.76 |
| Teacher characteristics | | | | | | |
| Female | 0.48 | 0.50 | 1.64E-01 | 1.18 | 0.15 | 1.32 |
| No prior experience | 0.04 | 0.19 | 4.14E-01 | 1.51 | 0.41 | 1.52 |
| 1 - 3 yrs experience | 0.11 | 0.31 | -6.26E-02 | 0.94 | 0.24 | -0.25 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|----------|-----------|-----------|---------------|---------------|---------|
| Total experience | 17.16 | 9.91 | -4.31E-02 | 0.96 | 0.01 | -4.04 |
| Age | 44.76 | 9.33 | 3.46E-01 | 1.41 | 0.38 | 1.29 |
| Age squared | 2,090.64 | 812.25 | -8.34E-03 | 0.99 | 0.01 | -1.32 |
| Age cubed | 1.01E+05 | 55,936.04 | 6.34E-05 | 1.00 | 0.00 | 1.32 |
| Education, BA or less | 0.07 | 0.25 | 2.48E-01 | 1.28 | 0.25 | 1.25 |
| Education, MA or more | 0.43 | 0.49 | 1.09E-01 | 1.12 | 0.14 | 0.84 |
| Black | 0.03 | 0.18 | 1.64E-01 | 1.18 | 0.36 | 0.54 |
| Hispanic | 0.08 | 0.28 | 5.25E-02 | 1.05 | 0.23 | 0.24 |
| Asian | 0.03 | 0.16 | 2.72E-03 | 1.00 | 0.37 | 0.01 |
| Am. Indian | 0.01 | 0.10 | -8.20E-02 | 0.92 | 0.58 | -0.13 |
| Number of ob | | | 21,137 | | | |
| Chi2 | | | 378.53 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.2a

**Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Transfer: All Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Dependent variable/Constant | 0.04 | 0.19 | -7.15 | | 1.15 | -6.21 |
| County characteristics | | | | | | |
| Population density | 1,355.44 | 2,266.33 | -8.54E-05 | 1.00 | 0.00 | -2.84 |
| Unemployment rate | 8.38 | 3.70 | 4.52E-03 | 1.00 | 0.01 | 0.37 |
| Per capita income | 23,252.70 | 5,232.56 | 1.27E-05 | 1.00 | 0.00 | 1.13 |
| Ave. wage | 28,581.10 | 5,431.42 | -2.25E-05 | 1.00 | 0.00 | -1.94 |
| Federal wage | 38,953.99 | 5,390.84 | 1.90E-05 | 1.00 | 0.00 | 1.66 |
| District characteristics | | | | | | |
| No. schools in district | 22.76 | 21.85 | -1.04E-02 | 0.99 | 0.01 | -1.18 |
| No. schools in district cubed | 66,110.02 | 2.11E+05 | 1.56E-06 | 1.00 | 0.00 | 2.38 |
| No. Pupils in district | 17,711.08 | 16,436.03 | 2.24E-05 | 1.00 | 0.00 | 1.93 |
| No. pupils in district cubed | 2.75E+13 | 8.16E+13 | -2.91E-15 | 1.00 | 0.00 | -2.86 |
| Rate of enrollment growth | 1.23 | 2.15 | 4.18E-02 | 1.04 | 0.02 | 1.94 |
| Maximum teachers' salary | 51,081.17 | 4,121.62 | 1.56E-05 | 1.00 | 0.00 | 2.09 |
| Inst. exp. /pupil | 1,873.81 | 176.03 | -6.57E-04 | 1.00 | 0.00 | -2.92 |
| Adm. exp./pupil | 198.26 | 34.31 | -1.44E-03 | 1.00 | 0.00 | -1.15 |
| Pct students nonwhite in district | 0.54 | 0.25 | -7.01E-02 | 0.93 | 0.20 | -0.33 |
| From (1995) school characteristics | | | | | | |
| No. Pupils in school | 1,049.38 | 706.66 | 9.72E-04 | 1.00 | 0.00 | 1.04 |
| No. pupils in school cubed | 3.33E+09 | 8.62E+09 | -1.72E-10 | 1.00 | 0.00 | -1.33 |
| Pct. students Black | 7.18 | 9.59 | 9.87E-02 | 1.10 | 0.02 | 5.82 |
| Pct. students Hispanic | 34.09 | 25.89 | 7.83E-02 | 1.08 | 0.01 | 8.76 |
| Pct. students Asian | 11.23 | 13.23 | -9.79E-03 | 0.99 | 0.02 | -0.58 |
| Pct. students Am Indian | 0.93 | 2.59 | 2.80E-02 | 1.03 | 0.03 | 1.14 |
| Pct. students Free lunch eligible | 41.25 | 27.46 | 1.93E-02 | 1.02 | 0.00 | 5.44 |
| Class size | 30.99 | 13.65 | 1.11E-03 | 1.00 | 0.00 | 0.64 |
| Urban | 0.29 | 0.45 | 4.01E-01 | 1.49 | 1.14 | 0.53 |
| To (1996) school characteristics | | | | | | |
| No. Pupils in school | 1,075.70 | 734.60 | -1.33E-03 | 1.00 | 0.00 | -1.55 |
| No. pupils in school cubed | 3.64E+09 | 9.35E+09 | 1.54E-10 | 1.00 | 0.00 | 1.48 |
| Pct. students Black | 7.16 | 9.49 | -9.33E-02 | 0.91 | 0.02 | -5.29 |
| Pct. students Hispanic | 34.93 | 26.24 | -7.84E-02 | 0.92 | 0.01 | -8.75 |
| Pct. students Asian | 11.35 | 13.51 | 3.36E-03 | 1.00 | 0.02 | 0.21 |
| Pct. students Am Indian | 0.92 | 2.48 | -3.72E-02 | 0.96 | 0.03 | -1.21 |
| Pct. students Free lunch eligible | 41.83 | 27.76 | -1.66E-02 | 0.98 | 0.00 | -5.50 |
| Class size | 29.31 | 12.80 | -5.61E-03 | 0.99 | 0.00 | -1.89 |
| Urban | 0.29 | 0.45 | -2.96E-01 | 0.74 | 0.57 | -0.39 |
| Teacher characteristics | | | | | | |
| Female | 0.71 | 0.46 | 4.81E-02 | 1.05 | 0.04 | 1.25 |
| No prior experience | 0.05 | 0.21 | 3.63E-01 | 1.44 | 0.10 | 5.11 |
| 1 - 3 yrs experience | 0.14 | 0.35 | 4.32E-02 | 1.04 | 0.06 | 0.77 |
| Total experience | 14.85 | 9.93 | -2.46E-02 | 0.98 | 0.00 | -7.71 |
| Age | 43.34 | 9.84 | 3.43E-01 | 1.41 | 0.10 | 4.91 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Age squared | 1,975.39 | 843.02 | -7.76E-03 | 0.99 | 0.00 | -4.70 |
| Age cubed | 93,844.84 | 57,198.35 | 5.43E-05 | 1.00 | 0.00 | 4.30 |
| Education, BA or less | 0.09 | 0.29 | 9.70E-02 | 1.10 | 0.08 | 1.27 |
| Education, MA or more | 0.31 | 0.46 | 2.05E-01 | 1.23 | 0.05 | 5.21 |
| Black | 0.03 | 0.18 | 5.34E-02 | 1.05 | 0.11 | 0.53 |
| Hispanic | 0.09 | 0.29 | 1.78E-02 | 1.02 | 0.06 | 0.32 |
| Asian | 0.04 | 0.20 | -2.96E-02 | 0.97 | 0.08 | -0.36 |
| Am. Indian | 0.01 | 0.09 | 2.15E-01 | 1.24 | 0.21 | 1.28 |
| Number of ob | | | 109,187 | | | |
| Chi2 | | | 1,000.79 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.2b
Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Transfer:
Grade K-3 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.04 | 0.21 | -7.33 | | 1.80 | -4.06 |
| County characteristics | | | | | | |
| Population density | 1,336.64 | 2,141.62 | -3.07E-05 | 1.00 | 0.00 | -0.86 |
| Unemployment rate | 8.38 | 3.66 | 1.98E-02 | 1.02 | 0.01 | 1.39 |
| Per capita income | 23,146.14 | 5,092.63 | -8.08E-06 | 1.00 | 0.00 | -0.50 |
| Ave. wage | 28,520.25 | 5,294.35 | 4.11E-06 | 1.00 | 0.00 | 0.25 |
| Federal wage | 38,931.40 | 5,317.86 | 1.11E-05 | 1.00 | 0.00 | 0.90 |
| District characteristics | | | | | | |
| No. schools in district | 23.25 | 21.56 | 8.53E-03 | 1.01 | 0.01 | 0.74 |
| No. schools in district cubed | 64,957.51 | 2.02E+05 | -5.71E-07 | 1.00 | 0.00 | -0.79 |
| No. Pupils in district | 17,592.46 | 16,631.15 | 9.25E-06 | 1.00 | 0.00 | 0.61 |
| No. pupils in district cubed | 2.79E+13 | 8.33E+13 | -1.33E-15 | 1.00 | 0.00 | -1.11 |
| Rate of enrollment growth | 1.14 | 2.11 | 2.32E-04 | 1.00 | 0.02 | 0.01 |
| Maximum teachers' salary | 51,043.96 | 4,161.98 | 1.81E-05 | 1.00 | 0.00 | 1.77 |
| Inst. exp. /pupil | 1,853.98 | 160.14 | -5.83E-04 | 1.00 | 0.00 | -2.37 |
| Adm. exp./pupil | 196.28 | 32.86 | 6.10E-04 | 1.00 | 0.00 | 0.50 |
| Pct students nonwhite in district | 0.55 | 0.25 | 1.81E-02 | 1.02 | 0.26 | 0.07 |
| From (1995) school characteristics | | | | | | |
| No. Pupils in school | 670.14 | 227.12 | 6.80E-03 | 1.01 | 0.00 | 4.85 |
| No. pupils in school cubed | 4.11E+08 | 4.75E+08 | -2.56E-09 | 1.00 | 0.00 | -3.93 |
| Pct. students Black | 7.41 | 10.08 | 1.19E-01 | 1.13 | 0.02 | 6.29 |
| Pct. students Hispanic | 36.94 | 27.66 | 7.61E-02 | 1.08 | 0.01 | 6.67 |
| Pct. students Asian | 10.10 | 12.67 | -1.35E-02 | 0.99 | 0.02 | -0.62 |
| Pct. students Am Indian | 0.88 | 2.84 | 1.33E-02 | 1.01 | 0.04 | 0.37 |
| Pct. students Free lunch eligible | 50.41 | 28.82 | 1.97E-02 | 1.02 | 0.00 | 4.27 |
| Class size | 29.19 | 5.38 | -1.79E-03 | 1.00 | 0.01 | -0.30 |
| Urban | 0.30 | 0.46 | 1.86E-01 | 1.20 | 1.12 | 0.20 |
| To (1996) school characteristics | | | | | | |
| No. Pupils in school | 679.56 | 236.82 | -7.17E-03 | 0.99 | 0.00 | -5.66 |
| No. pupils in school cubed | 4.39E+08 | 6.07E+08 | 2.43E-09 | 1.00 | 0.00 | 4.50 |
| Pct. students Black | 7.41 | 10.01 | -1.21E-01 | 0.89 | 0.02 | -6.06 |
| Pct. students Hispanic | 37.95 | 28.00 | -7.67E-02 | 0.93 | 0.01 | -6.74 |
| Pct. students Asian | 10.12 | 12.83 | 7.57E-03 | 1.01 | 0.02 | 0.35 |
| Pct. students Am Indian | 0.88 | 2.72 | -2.03E-02 | 0.98 | 0.04 | -0.45 |
| Pct. students Free lunch eligible | 50.77 | 29.19 | -1.81E-02 | 0.98 | 0.00 | -5.20 |
| Class size | 25.81 | 6.22 | -3.27E-03 | 1.00 | 0.01 | -0.65 |
| Urban | 0.30 | 0.46 | 8.77E-02 | 1.09 | 1.00 | 0.10 |
| Teacher characteristics | | | | | | |
| Female | 0.92 | 0.27 | -5.89E-02 | 0.94 | 0.08 | -0.67 |
| No prior experience | 0.05 | 0.22 | 3.34E-01 | 1.40 | 0.16 | 3.01 |
| 1 - 3 yrs experience | 0.15 | 0.35 | 8.22E-02 | 1.09 | 0.10 | 0.91 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|------------|------------|---------|
| Total experience | 14.16 | 9.66 | -2.56E-02 | 0.97 | 0.00 | -5.22 |
| Age | 42.87 | 10.02 | 3.01E-01 | 1.35 | 0.16 | 2.52 |
| Age squared | 1,938.49 | 856.33 | -6.72E-03 | 0.99 | 0.00 | -2.35 |
| Age cubed | 91,620.27 | 57,997.76 | 4.52E-05 | 1.00 | 0.00 | 2.05 |
| Education, BA or less | 0.11 | 0.31 | 2.17E-02 | 1.02 | 0.09 | 0.25 |
| Education, MA or more | 0.25 | 0.43 | 2.33E-01 | 1.26 | 0.08 | 3.80 |
| Black | 0.03 | 0.17 | -1.05E-01 | 0.90 | 0.15 | -0.62 |
| Hispanic | 0.12 | 0.32 | -1.34E-01 | 0.88 | 0.07 | -1.59 |
| Asian | 0.05 | 0.22 | -7.02E-02 | 0.93 | 0.11 | -0.60 |
| Am. Indian | 0.01 | 0.08 | 2.12E-01 | 1.24 | 0.37 | 0.71 |
| Number of ob | | | 39,642 | | | |
| Chi2 | | | 616.59 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.2c
Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Transfer:
Grade 4-6 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.05 | 0.22 | -8.99 | | 2.33 | -3.86 |
| County characteristics | | | | | | |
| Population density | 1,255.20 | 2,056.90 | -1.40E-04 | 1.00 | 0.00 | -3.21 |
| Unemployment rate | 8.58 | 3.85 | 3.74E-04 | 1.00 | 0.02 | 0.02 |
| Per capita income | 22,885.74 | 5,064.60 | 1.23E-05 | 1.00 | 0.00 | 0.74 |
| Ave. wage | 28,259.37 | 5,351.15 | -1.29E-05 | 1.00 | 0.00 | -0.75 |
| Federal wage | 38,638.37 | 5,472.28 | 1.28E-05 | 1.00 | 0.00 | 1.00 |
| District characteristics | | | | | | |
| No. schools in district | 22.21 | 20.76 | -5.40E-03 | 0.99 | 0.01 | -0.42 |
| No. schools in district cubed | 58,387.61 | 1.91E+05 | 1.35E-06 | 1.00 | 0.00 | 1.51 |
| No. Pupils in district | 16,586.79 | 15,636.15 | 1.47E-05 | 1.00 | 0.00 | 0.87 |
| No. pupils in district cubed | 2.33E+13 | 7.25E+13 | -2.54E-15 | 1.00 | 0.00 | -1.75 |
| Rate of enrollment growth | 1.15 | 2.14 | -1.20E-02 | 0.99 | 0.02 | -0.57 |
| Maximum teachers' salary | 50,855.69 | 4,163.62 | 2.90E-05 | 1.00 | 0.00 | 2.21 |
| Inst. exp. /pupil | 1,853.28 | 159.42 | -7.33E-04 | 1.00 | 0.00 | -2.18 |
| Adm. exp./pupil | 196.22 | 32.24 | -1.93E-03 | 1.00 | 0.00 | -1.22 |
| Pct students nonwhite in district | 0.54 | 0.25 | -3.48E-01 | 0.71 | 0.22 | -1.13 |
| From (1995) school characteristics | | | | | | |
| No. Pupils in school | 680.29 | 229.30 | 6.47E-03 | 1.01 | 0.00 | 2.87 |
| No. pupils in school cubed | 4.33E+08 | 5.42E+08 | -3.47E-09 | 1.00 | 0.00 | -3.11 |
| Pct. students Black | 7.04 | 9.69 | 6.26E-02 | 1.06 | 0.03 | 2.10 |
| Pct. students Hispanic | 35.16 | 26.99 | 6.37E-02 | 1.07 | 0.02 | 4.49 |
| Pct. students Asian | 10.18 | 12.74 | -3.48E-02 | 0.97 | 0.03 | -1.18 |
| Pct. students Am Indian | 0.93 | 2.81 | 1.15E-03 | 1.00 | 0.04 | 0.03 |
| Pct. students Free lunch eligible | 48.27 | 28.21 | 2.63E-02 | 1.03 | 0.01 | 4.66 |
| Class size | 29.85 | 4.81 | -1.45E-02 | 0.99 | 0.01 | -1.54 |
| Urban | 0.29 | 0.45 | 7.34E-01 | 2.08 | 2.75 | 0.56 |
| To (1996) school characteristics | | | | | | |
| No. Pupils in school | 691.21 | 242.25 | -6.36E-03 | 0.99 | 0.00 | -3.22 |
| No. pupils in school cubed | 4.68E+08 | 7.35E+08 | 3.10E-09 | 1.00 | 0.00 | 3.67 |
| Pct. students Black | 7.10 | 9.67 | -5.79E-02 | 0.94 | 0.03 | -1.87 |
| Pct. students Hispanic | 36.08 | 27.28 | -6.36E-02 | 0.94 | 0.01 | -4.49 |
| Pct. students Asian | 10.24 | 12.90 | 3.12E-02 | 1.03 | 0.03 | 1.11 |
| Pct. students Am Indian | 0.93 | 2.67 | 3.72E-03 | 1.00 | 0.05 | 0.08 |
| Pct. students Free lunch eligible | 48.74 | 28.60 | -2.26E-02 | 0.98 | 0.00 | -5.43 |
| Class size | 29.37 | 6.31 | -5.66E-02 | 0.94 | 0.01 | -4.93 |
| Urban | 0.29 | 0.45 | -5.62E-01 | 0.57 | 0.75 | -0.43 |
| Teacher characteristics | | | | | | |
| Female | 0.77 | 0.42 | 1.29E-01 | 1.14 | 0.09 | 1.61 |
| No prior experience | 0.05 | 0.21 | 5.33E-01 | 1.70 | 0.25 | 3.61 |
| 1 - 3 yrs experience | 0.15 | 0.35 | 1.48E-01 | 1.16 | 0.14 | 1.27 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|------------|------------|---------|
| Total experience | 13.96 | 9.65 | -7.52E-03 | 0.99 | 0.01 | -1.21 |
| Age | 42.91 | 9.72 | 5.70E-01 | 1.77 | 0.27 | 3.72 |
| Age squared | 1,935.58 | 828.77 | -1.27E-02 | 0.99 | 0.00 | -3.46 |
| Age cubed | 91,043.97 | 55,907.04 | 8.62E-05 | 1.00 | 0.00 | 3.02 |
| Education, BA or less | 0.09 | 0.29 | 7.45E-02 | 1.08 | 0.12 | 0.65 |
| Education, MA or more | 0.27 | 0.44 | 3.04E-01 | 1.35 | 0.11 | 3.68 |
| Black | 0.03 | 0.18 | 6.32E-02 | 1.07 | 0.19 | 0.35 |
| Hispanic | 0.08 | 0.27 | 6.67E-02 | 1.07 | 0.13 | 0.53 |
| Asian | 0.03 | 0.18 | -3.83E-02 | 0.96 | 0.18 | -0.21 |
| Am. Indian | 0.01 | 0.09 | 1.17E-01 | 1.12 | 0.38 | 0.34 |
| Number of ob | | | 20150 | | | |
| Chi2 | | | 391.36 | | | |
| Prob > chi2 | | | 0 | | | |

Table 5.2d
Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Transfer:
Grades 6-8 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.04 | 0.20 | -3.68 | | 2.97 | -1.24 |
| County characteristics | | | | | | |
| Population density | 1,400.06 | 2,457.31 | -1.52E-04 | 1.00 | 0.00 | -2.42 |
| Unemployment rate | 8.34 | 3.60 | -4.92E-02 | 0.95 | 0.02 | -2.37 |
| Per capita income | 23,365.77 | 5,332.30 | -2.91E-06 | 1.00 | 0.00 | -0.13 |
| Ave. wage | 28,628.21 | 5,396.29 | -4.55E-05 | 1.00 | 0.00 | -1.59 |
| Federal wage | 39,030.54 | 5,299.00 | 5.32E-05 | 1.00 | 0.00 | 3.11 |
| District characteristics | | | | | | |
| No. schools in district | 23.37 | 22.49 | -9.55E-03 | 0.99 | 0.02 | -0.46 |
| No. schools in district cubed | 72,236.58 | 2.28E+05 | 3.26E-06 | 1.00 | 0.00 | 2.28 |
| No. Pupils in district | 18,114.53 | 17,209.61 | 1.92E-05 | 1.00 | 0.00 | 0.80 |
| No. pupils in district cubed | 3.07E+13 | 8.94E+13 | -4.42E-15 | 1.00 | 0.00 | -2.13 |
| Rate of enrollment growth | 1.22 | 2.15 | 2.38E-02 | 1.02 | 0.04 | 0.66 |
| Maximum teachers' salary | 51,027.05 | 4,045.44 | -2.30E-05 | 1.00 | 0.00 | -1.17 |
| Inst. exp. /pupil | 1,866.34 | 166.45 | -5.98E-05 | 1.00 | 0.00 | -0.13 |
| Adm. exp./pupil | 198.21 | 30.64 | -5.71E-03 | 0.99 | 0.00 | -2.47 |
| Pct students nonwhite in district | 0.53 | 0.25 | 6.31E-01 | 1.88 | 1.28 | 0.93 |
| From (1995) school characteristics | | | | | | |
| No. Pupils in school | 951.59 | 386.21 | 8.61E-03 | 1.01 | 0.00 | 2.06 |
| No. pupils in school cubed | 1.42E+09 | 4.20E+09 | -2.17E-09 | 1.00 | 0.00 | -1.99 |
| Pct. students Black | 7.21 | 9.13 | 1.20E-01 | 1.13 | 0.05 | 2.48 |
| Pct. students Hispanic | 32.74 | 24.42 | 6.85E-02 | 1.07 | 0.03 | 2.61 |
| Pct. students Asian | 12.10 | 13.45 | -9.51E-03 | 0.99 | 0.05 | -0.20 |
| Pct. students Am Indian | 0.87 | 2.08 | 1.34E-01 | 1.14 | 0.06 | 2.67 |
| Pct. students Free lunch eligible | 40.69 | 24.69 | 4.75E-03 | 1.00 | 0.01 | 0.46 |
| Class size | 34.17 | 22.80 | 1.10E-03 | 1.00 | 0.00 | 0.34 |
| Urban | 0.30 | 0.46 | 2.00E+00 | 7.38 | 10.07 | 1.47 |
| To (1996) school characteristics | | | | | | |
| No. Pupils in school | 974.05 | 427.59 | -8.86E-03 | 0.99 | 0.00 | -2.50 |
| No. pupils in school cubed | 1.64E+09 | 5.04E+09 | 1.96E-09 | 1.00 | 0.00 | 2.36 |
| Pct. students Black | 7.24 | 9.13 | -1.09E-01 | 0.90 | 0.04 | -2.23 |
| Pct. students Hispanic | 33.45 | 24.73 | -6.16E-02 | 0.94 | 0.03 | -2.30 |
| Pct. students Asian | 12.13 | 13.71 | -2.96E-03 | 1.00 | 0.05 | -0.06 |
| Pct. students Am Indian | 0.84 | 1.95 | -9.64E-02 | 0.91 | 0.05 | -1.73 |
| Pct. students Free lunch eligible | 41.51 | 25.07 | -9.45E-03 | 0.99 | 0.01 | -1.00 |
| Class size | 33.40 | 19.87 | -5.06E-03 | 0.99 | 0.01 | -1.00 |
| Urban | 0.30 | 0.46 | -2.18E+00 | 0.11 | 0.16 | -1.58 |
| Teacher characteristics | | | | | | |
| Female | 0.59 | 0.49 | 5.78E-02 | 1.06 | 0.09 | 0.70 |
| No prior experience | 0.05 | 0.22 | 1.88E-01 | 1.21 | 0.21 | 1.06 |
| 1 - 3 yrs experience | 0.16 | 0.36 | 5.71E-02 | 1.06 | 0.14 | 0.45 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|------------|------------|---------|
| Total experience | 14.52 | 10.02 | -3.50E-02 | 0.97 | 0.01 | -4.16 |
| Age | 43.20 | 9.70 | 1.84E-01 | 1.20 | 0.23 | 0.98 |
| Age squared | 1,960.62 | 830.01 | -4.19E-03 | 1.00 | 0.00 | -0.95 |
| Age cubed | 92,693.26 | 56,125.75 | 3.20E-05 | 1.00 | 0.00 | 0.96 |
| Education, BA or less | 0.09 | 0.29 | 2.32E-01 | 1.26 | 0.21 | 1.40 |
| Education, MA or more | 0.33 | 0.47 | 2.95E-01 | 1.34 | 0.13 | 2.96 |
| Black | 0.04 | 0.19 | 2.00E-01 | 1.22 | 0.28 | 0.88 |
| Hispanic | 0.07 | 0.25 | 2.95E-01 | 1.34 | 0.19 | 2.09 |
| Asian | 0.04 | 0.19 | 2.20E-01 | 1.25 | 0.24 | 1.12 |
| Am. Indian | 0.01 | 0.09 | 1.56E-01 | 1.17 | 0.54 | 0.34 |
| Number of ob | | | 19,202 | | | |
| Chi2 | | | 295.88 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.2e
Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Transfer:
Grade 9-12 Math and Science Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.02 | 0.15 | -1.67 | | 4.73 | -0.35 |
| County characteristics | | | | | | |
| Population density | 1,462.33 | 2,472.30 | -2.17E-04 | 1.00 | 0.00 | -1.79 |
| Unemployment rate | 8.18 | 3.62 | -3.89E-02 | 0.96 | 0.06 | -0.64 |
| Per capita income | 23,672.40 | 5,426.24 | 4.62E-05 | 1.00 | 0.00 | 1.27 |
| Ave. wage | 28,982.98 | 5,642.10 | -3.76E-05 | 1.00 | 0.00 | -0.91 |
| Federal wage | 39,278.96 | 5,417.47 | 4.74E-06 | 1.00 | 0.00 | 0.08 |
| District characteristics | | | | | | |
| No. schools in district | 22.36 | 22.69 | -6.92E-02 | 0.93 | 0.02 | -3.12 |
| No. schools in district cubed | 70,901.66 | 2.30E+05 | 7.23E-06 | 1.00 | 0.00 | 2.92 |
| No. Pupils in district | 18,627.94 | 16,233.62 | 5.33E-05 | 1.00 | 0.00 | 1.65 |
| No. pupils in district cubed | 2.82E+13 | 8.11E+13 | -2.41E-15 | 1.00 | 0.00 | -0.61 |
| Rate of enrollment growth | 1.40 | 2.17 | 9.79E-02 | 1.10 | 0.08 | 1.36 |
| Maximum teachers' salary | 51,418.33 | 4,086.37 | 6.43E-05 | 1.00 | 0.00 | 2.10 |
| Inst. exp. /pupil | 1,919.31 | 200.88 | -1.56E-03 | 1.00 | 0.00 | -1.73 |
| Adm. exp./pupil | 202.15 | 38.81 | -4.24E-03 | 1.00 | 0.01 | -0.70 |
| Pct students nonwhite in district | 0.52 | 0.24 | 1.29E-01 | 1.14 | 1.08 | 0.14 |
| From (1995) school characteristics | | | | | | |
| No. Pupils in school | 1,876.27 | 815.54 | 3.73E-03 | 1.00 | 0.00 | 3.41 |
| No. pupils in school cubed | 1.05E+10 | 1.41E+10 | -2.20E-10 | 1.00 | 0.00 | -2.02 |
| Pct. students Black | 7.04 | 9.19 | 9.43E-02 | 1.10 | 0.08 | 1.23 |
| Pct. students Hispanic | 30.08 | 22.85 | -2.69E-02 | 0.97 | 0.05 | -0.56 |
| Pct. students Asian | 13.15 | 14.09 | -1.03E-01 | 0.90 | 0.05 | -1.75 |
| Pct. students Am Indian | 1.03 | 2.37 | 1.71E-02 | 1.02 | 0.20 | 0.09 |
| Pct. students Free lunch eligible | 24.50 | 17.35 | -3.28E-02 | 0.97 | 0.01 | -2.26 |
| Class size | 31.58 | 13.05 | -2.91E-04 | 1.00 | 0.01 | -0.05 |
| Urban | 0.28 | 0.45 | 2.33E+00 | 10.31 | 30.23 | 0.80 |
| To (1996) school characteristics | | | | | | |
| No. Pupils in school | 1,939.97 | 834.86 | -3.71E-03 | 1.00 | 0.00 | -3.56 |
| No. pupils in school cubed | 1.15E+10 | 1.52E+10 | 1.69E-10 | 1.00 | 0.00 | 1.97 |
| Pct. students Black | 6.90 | 8.88 | -9.38E-02 | 0.91 | 0.07 | -1.18 |
| Pct. students Hispanic | 30.79 | 23.27 | 1.07E-02 | 1.01 | 0.05 | 0.23 |
| Pct. students Asian | 13.49 | 14.53 | 8.74E-02 | 1.09 | 0.06 | 1.52 |
| Pct. students Am Indian | 1.01 | 2.32 | -2.42E-01 | 0.79 | 0.19 | -0.98 |
| Pct. students Free lunch eligible | 25.32 | 17.94 | 4.43E-02 | 1.05 | 0.01 | 3.39 |
| Class size | 31.00 | 14.19 | -1.84E-02 | 0.98 | 0.02 | -1.17 |
| Urban | 0.28 | 0.45 | -2.21E+00 | 0.11 | 0.33 | -0.74 |
| Teacher characteristics | | | | | | |
| Female | 0.35 | 0.48 | 2.10E-01 | 1.23 | 0.20 | 1.29 |
| No prior experience | 0.05 | 0.21 | 9.02E-01 | 2.46 | 0.78 | 2.84 |
| 1 - 3 yrs experience | 0.14 | 0.34 | -5.93E-02 | 0.94 | 0.28 | -0.20 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|-----------|-----------|-----------|---------------|---------------|---------|
| Total experience | 15.45 | 10.13 | -1.44E-02 | 0.99 | 0.01 | -1.29 |
| Age | 43.24 | 9.77 | -1.11E-02 | 0.99 | 0.32 | -0.03 |
| Age squared | 1,965.31 | 837.33 | 2.94E-04 | 1.00 | 0.01 | 0.04 |
| Age cubed | 93,103.34 | 56,632.78 | -1.21E-06 | 1.00 | 0.00 | -0.02 |
| Education, BA or less | 0.09 | 0.28 | 4.06E-01 | 1.50 | 0.53 | 1.16 |
| Education, MA or more | 0.43 | 0.49 | -3.40E-02 | 0.97 | 0.17 | -0.19 |
| Black | 0.03 | 0.17 | -2.79E-01 | 0.76 | 0.38 | -0.56 |
| Hispanic | 0.06 | 0.24 | -1.73E-02 | 0.98 | 0.29 | -0.06 |
| Asian | 0.05 | 0.22 | 4.77E-02 | 1.05 | 0.31 | 0.16 |
| Am. Indian | 0.01 | 0.09 | -1.39E-01 | 0.87 | 0.91 | -0.13 |
| Number of ob | | | 8,348 | | | |
| Chi2 | | | 218.71 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.2f
Logistic Regression Results: Odds That Teachers
Employed in 1995 Will Transfer:
Grades 9-12 Other Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|------------------------------------|-----------|-----------|-----------|------------|------------|---------|
| Dependent variable/Constant | 0.02 | 0.15 | -6.19 | | 3.41 | -1.82 |
| County characteristics | | | | | | |
| Population density | 1,402.54 | 2,406.86 | -1.38E-04 | 1.00 | 0.00 | -1.32 |
| Unemployment rate | 8.33 | 3.76 | 2.47E-02 | 1.02 | 0.05 | 0.47 |
| Per capita income | 23,527.39 | 5,441.19 | 5.71E-05 | 1.00 | 0.00 | 1.80 |
| Ave. wage | 28,795.44 | 5,676.44 | -1.97E-05 | 1.00 | 0.00 | -0.61 |
| Federal wage | 39,096.30 | 5,501.68 | -2.81E-05 | 1.00 | 0.00 | -0.51 |
| District characteristics | | | | | | |
| No. schools in district | 21.97 | 22.41 | -8.27E-02 | 0.92 | 0.02 | -4.61 |
| No. schools in district cubed | 68,140.95 | 2.24E+05 | 5.88E-06 | 1.00 | 0.00 | 2.83 |
| No. Pupils in district | 18,264.16 | 16,118.94 | 8.08E-05 | 1.00 | 0.00 | 3.01 |
| No. pupils in district cubed | 2.73E+13 | 7.94E+13 | -3.77E-15 | 1.00 | 0.00 | -1.20 |
| Rate of enrollment growth | 1.43 | 2.20 | 1.64E-01 | 1.18 | 0.08 | 2.33 |
| Maximum teachers' salary | 51,277.10 | 4,072.31 | 2.46E-05 | 1.00 | 0.00 | 0.94 |
| Inst. exp. /pupil | 1,918.22 | 203.21 | -1.34E-03 | 1.00 | 0.00 | -1.85 |
| Adm. exp./pupil | 202.30 | 39.16 | -2.20E-03 | 1.00 | 0.01 | -0.42 |
| Pct students nonwhite in district | 0.52 | 0.24 | -2.23E-01 | 0.80 | 0.59 | -0.31 |
| From (1995) school characteristics | | | | | | |
| No. Pupils in school | 1,853.78 | 819.01 | 2.21E-03 | 1.00 | 0.00 | 2.71 |
| No. pupils in school cubed | 1.03E+10 | 1.37E+10 | -7.30E-11 | 1.00 | 0.00 | -1.57 |
| Pct. students Black | 6.91 | 9.13 | 7.67E-02 | 1.08 | 0.08 | 1.07 |
| Pct. students Hispanic | 30.59 | 23.01 | 1.14E-01 | 1.12 | 0.04 | 2.86 |
| Pct. students Asian | 12.77 | 13.85 | 1.93E-02 | 1.02 | 0.06 | 0.33 |
| Pct. students Am Indian | 1.06 | 2.39 | 2.26E-01 | 1.25 | 0.30 | 0.95 |
| Pct. students Free lunch eligible | 24.94 | 17.48 | -7.02E-03 | 0.99 | 0.01 | -0.67 |
| Class size | 32.31 | 17.86 | -3.99E-05 | 1.00 | 0.00 | -0.01 |
| Urban | 0.28 | 0.45 | -2.58E+00 | 0.08 | 0.18 | -1.11 |
| To (1996) school characteristics | | | | | | |
| No. Pupils in school | 1,914.31 | 837.42 | -2.30E-03 | 1.00 | 0.00 | -2.50 |
| No. pupils in school cubed | 1.12E+10 | 1.47E+10 | 3.00E-11 | 1.00 | 0.00 | 0.58 |
| Pct. students Black | 6.79 | 8.87 | -6.38E-02 | 0.94 | 0.07 | -0.85 |
| Pct. students Hispanic | 31.24 | 23.41 | -1.23E-01 | 0.88 | 0.04 | -3.08 |
| Pct. students Asian | 13.09 | 14.30 | -2.16E-02 | 0.98 | 0.06 | -0.38 |
| Pct. students Am Indian | 1.04 | 2.29 | -4.92E-01 | 0.61 | 0.20 | -1.54 |
| Pct. students Free lunch eligible | 25.69 | 17.92 | 2.05E-02 | 1.02 | 0.01 | 1.81 |
| Class size | 31.39 | 15.69 | 2.53E-03 | 1.00 | 0.00 | 0.64 |
| Urban | 0.28 | 0.45 | 2.52E+00 | 12.43 | 28.97 | 1.08 |
| Teacher characteristics | | | | | | |
| Female | 0.48 | 0.50 | 1.98E-01 | 1.22 | 0.12 | 2.09 |
| No prior experience | 0.04 | 0.20 | 4.96E-01 | 1.64 | 0.35 | 2.32 |
| 1 - 3 yrs experience | 0.12 | 0.32 | -5.16E-02 | 0.95 | 0.17 | -0.29 |

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------|----------|-----------|-----------|------------|------------|---------|
| Total experience | 17.00 | 10.20 | -2.40E-02 | 0.98 | 0.01 | -2.90 |
| Age | 44.77 | 9.60 | 3.62E-01 | 1.44 | 0.24 | 2.14 |
| Age squared | 2,096.46 | 834.05 | -8.16E-03 | 0.99 | 0.00 | -2.07 |
| Age cubed | 1.02E+05 | 57,363.68 | 5.78E-05 | 1.00 | 0.00 | 1.97 |
| Education, BA or less | 0.08 | 0.27 | 1.06E-01 | 1.11 | 0.29 | 0.40 |
| Education, MA or more | 0.42 | 0.49 | -4.11E-02 | 0.96 | 0.09 | -0.42 |
| Black | 0.03 | 0.18 | 1.94E-01 | 1.21 | 0.37 | 0.63 |
| Hispanic | 0.09 | 0.28 | 1.56E-01 | 1.17 | 0.17 | 1.11 |
| Asian | 0.03 | 0.17 | -2.14E-02 | 0.98 | 0.32 | -0.07 |
| Am. Indian | 0.01 | 0.10 | 5.39E-01 | 1.71 | 0.56 | 1.64 |
| Number of ob | | | 21,845 | | | |
| Chi2 | | | 293.90 | | | |
| Prob > chi2 | | | 0.00 | | | |

The Supply Of Credentialed Newly Hired Teachers

The third source of teachers to a school is the pool of newly hired teachers. The district recruits teachers from outside the district, decides which applicants will be employed, and assigns newly hired teachers to the positions left vacant after returning teachers have distributed themselves throughout the district. Newly hired teachers include both credentialed teachers and underqualified teachers. The first question is whether the characteristics of a school's pupil population affect the likelihood that the newly hired teachers the district assigns to that school are fully credentialed.

Our data allow us to identify those teachers who were employed in each school in 1995 and in 1996 who had not been employed in that school's district the prior year. We used these data to explore the factors related to the assignment of newly hired teachers among the schools in the district. Specifically, for the subset of teachers who were newly hired by a district in our sample in 1995 or in 1996, we defined an indicator variable which had the value zero if a teacher was not credentialed and one if the teacher had a teaching credential. We regress this indicator on measures of the factors that might be related to a district's assignment policies. We perform separate regressions for the newly hired teachers in 1995 and for those newly hired in 1996 for all teachers in the sample

combined and for five separate groups of teachers divided by the grade level of their teaching assignment.

We explore the possibility that district assignment policies are related to characteristics of the county in which the district is located, of the district, of the students in the schools to which a teacher is assigned, and of the teacher. We include the characteristics of the county in which the district is located and the district characteristics defined earlier. We also include the teacher's age, gender, experience, and education level.

Preliminary analyses suggested that the effects of some of the independent variables was nonlinear. To control for nonlinearities, we included those independent variables both linearly and squared or cubed.

The results of logistic regressions of the indicator on the independent variables for the assignment of newly hired teachers in 1995 are presented in Table 5.3. Table 5.4 presents the corresponding results for the assignment of teachers in 1996. The standard errors and z-scores reported in Tables 5.3 and 5.4 have been adjusted to reflect the clustering of observations by school.

Table 5.3a
Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1995 Will Be Credentialed:
All Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|------------|------------|---------|
| Dependent Variable/Constant | 0.90 | 0.29 | 4.195 | | 0.43 | 9.79 |
| No. Pupils in school | 1,069.02 | 717.25 | 0.000 | 1.00 | 0.00 | -4.55 |
| No. pupils in school cubed | 3.50E+09 | 9.25E+09 | 0.000 | 1.00 | 0.00 | 0.50 |
| Pct. students Black | 8.05 | 11.21 | -0.028 | 0.97 | 0.00 | -7.49 |
| Pct. students Hispanic | 35.89 | 26.23 | -0.018 | 0.98 | 0.00 | -7.29 |
| Pct. students Asian | 10.23 | 12.38 | -0.006 | 0.99 | 0.00 | -1.30 |
| Pct. students Am Indian | 0.54 | 2.19 | -0.017 | 0.98 | 0.02 | -1.05 |
| Pct. students Free lunch eligible | 42.10 | 28.48 | -0.003 | 1.00 | 0.00 | -1.13 |
| Class size | 30.75 | 16.02 | -0.001 | 1.00 | 0.00 | -0.51 |
| Rural | 0.05 | 0.23 | -0.443 | 0.64 | 0.14 | -2.05 |
| Urban | 0.29 | 0.46 | 0.071 | 1.07 | 0.11 | 0.73 |
| Female | 0.71 | 0.46 | 0.471 | 1.60 | 0.11 | 6.72 |
| No prior experience | 0.47 | 0.50 | -0.268 | 0.76 | 0.07 | -2.84 |
| 1 – 3 yrs experience | 0.62 | 0.48 | -0.071 | 0.93 | 0.15 | -0.44 |
| Total experience | 5.46 | 7.41 | 0.104 | 1.11 | 0.03 | 4.42 |
| Total experience cubed | 1,963.26 | 7,256.79 | 0.000 | 1.00 | 0.00 | -1.97 |
| Age | 35.15 | 9.94 | 0.014 | 1.01 | 0.01 | 1.04 |
| Age cubed | 5.46E+04 | 4.92E+04 | 0.000 | 1.00 | 0.00 | -0.32 |
| Education, BA or less | 0.25 | 0.43 | -1.474 | 0.23 | 0.02 | -19.02 |
| Education, MA or more | 0.20 | 0.40 | -0.710 | 0.49 | 0.05 | -6.68 |
| Asian | 0.05 | 0.23 | -0.337 | 0.71 | 0.10 | -2.45 |
| Black | 0.04 | 0.20 | -0.773 | 0.46 | 0.07 | -5.16 |
| Hispanic | 0.14 | 0.35 | -0.945 | 0.39 | 0.03 | -11.19 |
| Am. Indian | 0.01 | 0.09 | -0.376 | 0.69 | 0.27 | -0.96 |
| Race/ethnicity unknown | 0.01 | 0.08 | -0.748 | 0.47 | 0.16 | -2.23 |
| No. of obs. | | | 14,291 | | | |
| Chi2 | | | 1119 | | | |
| Prob > chi2 | | | 0.000 | | | |

Table 5.3b

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1995 Will Be Credentialed:
Grade K-3 Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.90 | 0.29 | 5.833 | | 0.92 | 6.36 |
| No. Pupils in school | 680.34 | 232.02 | -0.001 | 1.00 | 0.00 | -1.15 |
| No. pupils in school cubed | 4.30E+08 | 4.64E+08 | 0.000 | 1.00 | 0.00 | -0.59 |
| Pct. students Black | 8.50 | 12.03 | -0.038 | 0.96 | 0.01 | -5.84 |
| Pct. students Hispanic | 41.19 | 28.25 | -0.022 | 0.98 | 0.01 | -4.22 |
| Pct. students Asian | 8.90 | 11.51 | -0.009 | 0.99 | 0.01 | -1.02 |
| Pct. students Am Indian | 0.43 | 1.92 | -0.037 | 0.96 | 0.03 | -1.21 |
| Pct. students Free lunch eligible | 53.85 | 29.51 | -0.001 | 1.00 | 0.00 | -0.30 |
| Class size | 28.77 | 7.26 | -0.002 | 1.00 | 0.01 | -0.36 |
| Rural | 0.04 | 0.20 | -0.376 | 0.69 | 0.27 | -0.95 |
| Urban | 0.29 | 0.46 | 0.063 | 1.07 | 0.17 | 0.40 |
| Female | 0.90 | 0.30 | 0.600 | 1.82 | 0.29 | 3.79 |
| No prior experience | 0.49 | 0.50 | -0.339 | 0.71 | 0.12 | -1.97 |
| 1 - 3 yrs experience | 0.64 | 0.48 | -0.324 | 0.72 | 0.22 | -1.07 |
| Total experience | 5.10 | 7.09 | 0.020 | 1.02 | 0.04 | 0.50 |
| Total experience cubed | 1763.38 | 7222.38 | 0.000 | 1.00 | 0.00 | 0.19 |
| Age | 34.09 | 9.61 | -0.010 | 0.99 | 0.03 | -0.36 |
| Age cubed | 49799.65 | 45899.01 | 0.000 | 1.00 | 0.00 | 0.93 |
| Education, BA or less | 0.28 | 0.45 | -1.493 | 0.22 | 0.03 | -10.98 |
| Education, MA or more | 0.15 | 0.36 | -0.521 | 0.59 | 0.13 | -2.32 |
| Asian | 0.06 | 0.23 | -0.416 | 0.66 | 0.15 | -1.79 |
| Black | 0.04 | 0.19 | -0.699 | 0.50 | 0.14 | -2.56 |
| Hispanic | 0.20 | 0.40 | -1.278 | 0.28 | 0.04 | -9.18 |
| Am. Indian | 0.00 | 0.07 | -0.484 | 0.62 | 0.44 | -0.68 |
| Race/ethnicity unknown | 0.01 | 0.08 | -0.75 | 0.4732 | 0.16 | -2.228 |
| No. of obs. | | | 4,888 | | | |
| Chi2 | | | 523.76 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.3c

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1995 Will Be Credentialed:
Grade 4-6 Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.92 | 0.28 | 4.54 | | 1.25 | 3.64 |
| No. Pupils in school | 692.30 | 246.12 | 0.000 | 1.00 | 0.00 | 0.52 |
| No. pupils in school cubed | 4.70E+08 | 6.09E+08 | 0.000 | 1.00 | 0.00 | -2.39 |
| Pct. students Black | 8.59 | 12.22 | -0.033 | 0.97 | 0.01 | -3.68 |
| Pct. students Hispanic | 39.80 | 28.00 | -0.026 | 0.97 | 0.01 | -3.83 |
| Pct. students Asian | 9.32 | 12.24 | -0.015 | 0.99 | 0.01 | -1.35 |
| Pct. students Am Indian | 0.55 | 2.93 | -0.024 | 0.98 | 0.02 | -1.04 |
| Pct. students Free lunch eligible | 53.00 | 29.03 | 0.004 | 1.00 | 0.01 | 0.71 |
| Class size | 29.77 | 6.82 | -0.018 | 0.98 | 0.01 | -2.53 |
| Rural | 0.05 | 0.22 | -0.670 | 0.51 | 0.34 | -1.00 |
| Urban | 0.29 | 0.45 | 0.004 | 1.00 | 0.23 | 0.02 |
| Female | 0.78 | 0.41 | 0.612 | 1.84 | 0.36 | 3.13 |
| No prior experience | 0.50 | 0.50 | -0.825 | 0.44 | 0.12 | -2.92 |
| 1 – 3 yrs experience | 0.65 | 0.48 | 0.690 | 1.99 | 0.96 | 1.43 |
| Total experience | 5.24 | 7.38 | 0.146 | 1.16 | 0.08 | 2.21 |
| Total experience cubed | 1895.06 | 6464.37 | 0.000 | 1.00 | 0.00 | -1.86 |
| Age | 34.45 | 9.73 | 0.000 | 1.00 | 0.04 | 0.00 |
| Age cubed | 51411.00 | 47382.70 | 0.000 | 1.00 | 0.00 | 0.27 |
| Education, BA or less | 0.25 | 0.43 | -1.215 | 0.30 | 0.06 | -5.83 |
| Education, MA or more | 0.16 | 0.37 | 0.133 | 1.14 | 0.38 | 0.40 |
| Asian | 0.04 | 0.20 | -0.664 | 0.51 | 0.19 | -1.80 |
| Black | 0.05 | 0.22 | -1.510 | 0.22 | 0.07 | -4.49 |
| Hispanic | 0.15 | 0.36 | -1.170 | 0.31 | 0.07 | -5.46 |
| Am. Indian | 0.01 | 0.09 | -1.396 | 0.25 | 0.26 | -1.34 |
| Race/ethnicity unknown | 0.01 | 0.08 | -0.653 | 0.52 | 0.57 | -0.60 |
| No. of obs. | | | 2,202 | | | |
| Chi2 | | | 246.30 | | | |
| Prob > chi2 | | | 0 | | | |

Table 5.3d
Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1995 Will Be Credentialed:
Grade 6-8 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.90 | 0.30 | 4.28 | | 1.00 | 4.28 |
| No. Pupils in school | 933.68 | 395.34 | 0.000 | 1.00 | 0.00 | -1.02 |
| No. pupils in school cubed | 1.38E+09 | 4.10E+09 | 0.000 | 1.00 | 0.00 | 0.97 |
| Pct. students Black | 7.85 | 10.49 | -0.020 | 0.98 | 0.01 | -2.23 |
| Pct. students Hispanic | 32.72 | 24.28 | -0.017 | 0.98 | 0.01 | -3.01 |
| Pct. students Asian | 10.78 | 12.13 | -0.001 | 1.00 | 0.01 | -0.15 |
| Pct. students Am Indian | 0.54 | 2.08 | -0.058 | 0.94 | 0.03 | -2.07 |
| Pct. students Free lunch eligible | 40.43 | 24.83 | -0.002 | 1.00 | 0.01 | -0.38 |
| Class size | 33.60 | 25.08 | 0.002 | 1.00 | 0.00 | 0.49 |
| Rural | 0.05 | 0.23 | 1.044 | 2.84 | 1.67 | 1.77 |
| Urban | 0.30 | 0.46 | 0.098 | 1.10 | 0.21 | 0.51 |
| Female | 0.61 | 0.49 | 0.622 | 1.86 | 0.25 | 4.56 |
| No prior experience | 0.46 | 0.50 | -0.401 | 0.67 | 0.13 | -2.11 |
| 1 - 3 yrs experience | 0.63 | 0.48 | -0.886 | 0.41 | 0.17 | -2.17 |
| Total experience | 5.26 | 7.20 | 0.017 | 1.02 | 0.06 | 0.26 |
| Total experience cubed | 1833.43 | 7473.86 | 0.000 | 1.00 | 0.00 | 1.20 |
| Age | 35.40 | 9.73 | 0.028 | 1.03 | 0.03 | 0.99 |
| Age cubed | 5.51E+04 | 48022.86 | 0.000 | 1.00 | 0.00 | -1.14 |
| Education, BA or less | 0.25 | 0.43 | -1.806 | 0.16 | 0.03 | -10.82 |
| Education, MA or more | 0.21 | 0.41 | -1.102 | 0.33 | 0.08 | -4.83 |
| Asian | 0.05 | 0.22 | -0.230 | 0.79 | 0.23 | -0.79 |
| Black | 0.04 | 0.20 | -0.928 | 0.40 | 0.12 | -3.02 |
| Hispanic | 0.10 | 0.30 | -0.336 | 0.71 | 0.15 | -1.64 |
| Am. Indian | 0.01 | 0.10 | -0.916 | 0.40 | 0.25 | -1.48 |
| Race/ethnicity unknown | 0.00 | 0.06 | -1.716 | 0.18 | 0.13 | -2.41 |
| No. of obs. | | | 2,931 | | | |
| Chi2 | | | 274.88 | | | |
| Prob > chi2 | | | 0 | | | |

Table 5.3e

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1995 Will Be Credentialed:
Grade 9-12 Math and Science Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.87 | 0.33 | 3.74 | | 1.18 | 3.16 |
| No. Pupils in school | 1839.06 | 851.66 | -0.001 | 1.00 | 0.00 | -2.22 |
| No. pupils in school cubed | 1.05E+10 | 1.50E+10 | 0.000 | 1.00 | 0.00 | 0.02 |
| Pct. students Black | 7.69 | 10.28 | -0.025 | 0.98 | 0.01 | -2.43 |
| Pct. students Hispanic | 31.10 | 23.04 | -0.018 | 0.98 | 0.01 | -3.44 |
| Pct. students Asian | 12.26 | 13.55 | -0.003 | 1.00 | 0.01 | -0.28 |
| Pct. students Am Indian | 0.58 | 2.05 | -0.033 | 0.97 | 0.04 | -0.86 |
| Pct. students Free lunch eligible | 24.24 | 17.48 | -0.008 | 0.99 | 0.01 | -1.10 |
| Class size | 31.99 | 14.12 | 0.001 | 1.00 | 0.01 | 0.23 |
| Rural | 0.06 | 0.24 | -0.609 | 0.54 | 0.24 | -1.36 |
| Urban | 0.28 | 0.45 | -0.206 | 0.81 | 0.20 | -0.84 |
| Female | 0.41 | 0.49 | 0.030 | 1.03 | 0.19 | 0.17 |
| No prior experience | 0.42 | 0.49 | -0.325 | 0.72 | 0.18 | -1.29 |
| 1 – 3 yrs experience | 0.59 | 0.49 | -0.036 | 0.97 | 0.40 | -0.09 |
| Total experience | 5.42 | 6.95 | 0.164 | 1.18 | 0.07 | 2.72 |
| Total experience cubed | 1,705.22 | 6,633.72 | 0.000 | 1.00 | 0.00 | -2.45 |
| Age | 35.97 | 10.04 | 0.028 | 1.03 | 0.04 | 0.74 |
| Age cubed | 5.81E+04 | 5.13E+04 | 0.000 | 1.00 | 0.00 | -0.61 |
| Education, BA or less | 0.24 | 0.43 | -1.179 | 0.31 | 0.07 | -5.51 |
| Education, MA or more | 0.28 | 0.45 | -0.545 | 0.58 | 0.15 | -2.15 |
| Asian | 0.08 | 0.26 | -0.182 | 0.83 | 0.28 | -0.54 |
| Black | 0.04 | 0.20 | -0.299 | 0.74 | 0.29 | -0.77 |
| Hispanic | 0.07 | 0.26 | -0.583 | 0.56 | 0.14 | -2.26 |
| Am. Indian | 0.01 | 0.11 | 0.046 | 1.05 | 1.01 | 0.05 |
| Race/ethnicity unknown | 0.01 | 0.09 | -0.702 | 0.50 | 0.35 | -0.98 |
| No. of obs. | | | 1,390 | | | |
| Chi2 | | | 145.15 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.3f

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1995 Will Be Credentialed:
Grade 9-12 Other Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.914 | 0.281 | 3.41 | | 0.96 | 3.54 |
| No. Pupils in school | 1793.64 | 849.55 | 0.000 | 1.00 | 0.00 | -0.77 |
| No. pupils in school cubed | 9.90E+09 | 1.44E+10 | 0.000 | 1.00 | 0.00 | -1.94 |
| Pct. students Black | 7.23 | 9.93 | -0.027 | 0.97 | 0.01 | -3.08 |
| Pct. students Hispanic | 29.33 | 21.85 | -0.010 | 0.99 | 0.00 | -2.29 |
| Pct. students Asian | 11.68 | 13.26 | -0.007 | 0.99 | 0.01 | -0.90 |
| Pct. students Am Indian | 0.69 | 2.14 | 0.038 | 1.04 | 0.04 | 0.96 |
| Pct. students Free lunch eligible | 23.86 | 17.55 | -0.001 | 1.00 | 0.01 | -0.24 |
| Class size | 31.39 | 19.96 | -0.001 | 1.00 | 0.00 | -0.25 |
| Rural | 0.07 | 0.26 | -0.987 | 0.37 | 0.13 | -2.86 |
| Urban | 0.29 | 0.45 | 0.277 | 1.32 | 0.29 | 1.27 |
| Female | 0.55 | 0.50 | 0.201 | 1.22 | 0.19 | 1.29 |
| No prior experience | 0.43 | 0.50 | -0.059 | 0.94 | 0.23 | -0.24 |
| 1 - 3 yrs experience | 0.58 | 0.49 | 0.118 | 1.12 | 0.40 | 0.33 |
| Total experience | 6.46 | 8.28 | 0.127 | 1.14 | 0.08 | 1.70 |
| Total experience cubed | 2,619.65 | 7,897.15 | 0.000 | 1.00 | 0.00 | 0.54 |
| Age | 36.85 | 10.52 | 0.003 | 1.00 | 0.03 | 0.11 |
| Age cubed | 6.29E+04 | 5.48E+04 | 0.000 | 1.00 | 0.00 | 0.49 |
| Education, BA or less | 0.23 | 0.42 | -1.497 | 0.22 | 0.04 | -8.59 |
| Education, MA or more | 0.28 | 0.45 | -0.876 | 0.42 | 0.09 | -4.15 |
| Asian | 0.04 | 0.21 | -0.103 | 0.90 | 0.31 | -0.30 |
| Black | 0.04 | 0.19 | -0.536 | 0.58 | 0.20 | -1.57 |
| Hispanic | 0.11 | 0.32 | -0.668 | 0.51 | 0.11 | -3.15 |
| Am. Indian | 0.01 | 0.11 | -0.232 | 0.79 | 0.63 | -0.29 |
| Race/ethnicity unknown | 0.01 | 0.09 | -0.978 | 0.38 | 0.24 | -1.55 |
| No. of obs. | | | 2,852 | | | |
| Chi2 | | | 195.63 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.4a

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1996 Will Be Credentialed:
All Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|----------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.84 | 0.37 | 4.52 | | 0.31 | 14.70 |
| No. Pupils in school | 987.83 | 686.02 | 0.000 | 1.00 | 0.00 | -3.81 |
| No. pupils in school cubed | 3.01E+09 | 9.38E+09 | 0.000 | 1.00 | 0.00 | 0.97 |
| Pct. students Black | 7.99 | 10.71 | -0.026 | 0.97 | 0.00 | -9.16 |
| Pct. students Hispanic | 37.14 | 27.02 | -0.020 | 0.98 | 0.00 | -10.12 |
| Pct. students Asian | 10.39 | 12.38 | -0.001 | 1.00 | 0.00 | -0.48 |
| Pct. students Am Indian | 0.86 | 2.46 | 0.000 | 1.00 | 0.02 | -0.03 |
| Pct. students Free lunch eligible | 44.75 | 29.09 | 0.000 | 1.00 | 0.00 | -0.23 |
| Class size | 26.98 | 12.98 | 0.001 | 1.00 | 0.00 | 0.37 |
| Rural | 0.05 | 0.22 | 0.000 | 1.00 | 0.15 | 0.00 |
| Urban | 0.28 | 0.45 | 0.036 | 1.04 | 0.07 | 0.55 |
| Female | 0.75 | 0.44 | 0.295 | 1.34 | 0.07 | 6.07 |
| No prior experience | 0.52 | 0.50 | -0.626 | 0.53 | 0.04 | -9.02 |
| 1 - 3 yrs experience | 0.68 | 0.47 | -0.201 | 0.82 | 0.10 | -1.61 |
| Total experience | 4.55 | 6.51 | 0.071 | 1.07 | 0.02 | 3.44 |
| Total experience cubed | 1385.17 | 5692.09 | 0.000 | 1.00 | 0.00 | 0.40 |
| Age | 35.00 | 9.85 | -0.019 | 0.98 | 0.01 | -1.89 |
| Age cubed | 53765.24 | 48017.80 | 0.000 | 1.00 | 0.00 | 2.69 |
| Education, BA or less | 0.30 | 0.46 | -1.621 | 0.20 | 0.01 | -31.59 |
| Education, MA or more | 0.17 | 0.38 | -0.652 | 0.52 | 0.04 | -8.82 |
| Asian | 0.05 | 0.21 | -0.161 | 0.85 | 0.08 | -1.69 |
| Black | 0.04 | 0.20 | -0.735 | 0.48 | 0.05 | -6.95 |
| Hispanic | 0.14 | 0.35 | -0.630 | 0.53 | 0.03 | -10.76 |
| Am. Indian | 0.01 | 0.09 | -0.106 | 0.90 | 0.23 | -0.42 |
| Race/ethnicity unknown | 0.01 | 0.07 | -0.005 | 0.99 | 0.27 | -0.02 |
| No. of obs. | | | 23,300 | | | |
| Chi2 | | | 2,461.86 | | | |
| Prob > chi2 | | | 0.0 | | | |

Table 5.4b

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1996 Will Be Credentialed:
Grade K-3 Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.83 | 0.37 | 5.13 | | 0.49 | 10.37 |
| No. Pupils in school | 674.99 | 243.21 | -0.001 | 1.00 | 0.00 | -2.53 |
| No. pupils in school cubed | 4.47E+08 | 1.46E+09 | 0.000 | 1.00 | 0.00 | 0.99 |
| Pct. students Black | 7.83 | 10.75 | -0.030 | 0.97 | 0.00 | -6.84 |
| Pct. students Hispanic | 39.23 | 28.58 | -0.024 | 0.98 | 0.00 | -7.37 |
| Pct. students Asian | 9.44 | 11.82 | -0.002 | 1.00 | 0.00 | -0.38 |
| Pct. students Am Indian | 0.81 | 2.47 | 0.031 | 1.03 | 0.05 | 0.69 |
| Pct. students Free lunch eligible | 51.89 | 30.00 | 0.001 | 1.00 | 0.00 | 0.33 |
| Class size | 22.80 | 7.16 | 0.016 | 1.02 | 0.01 | 3.08 |
| Rural | 0.05 | 0.22 | 0.353 | 1.42 | 0.38 | 1.34 |
| Urban | 0.28 | 0.45 | -0.004 | 1.00 | 0.09 | -0.04 |
| Female | 0.90 | 0.30 | 0.356 | 1.43 | 0.12 | 4.20 |
| No prior experience | 0.56 | 0.50 | -0.798 | 0.45 | 0.05 | -7.51 |
| 1 - 3 yrs experience | 0.71 | 0.45 | -0.340 | 0.71 | 0.14 | -1.77 |
| Total experience | 3.99 | 5.82 | 0.042 | 1.04 | 0.03 | 1.36 |
| Total experience cubed | 1.04E+03 | 4.89E+03 | 0.000 | 1.00 | 0.00 | 0.50 |
| Age | 34.42 | 9.62 | -0.037 | 0.96 | 0.01 | -2.44 |
| Age cubed | 5.10E+04 | 4.60E+04 | 0.000 | 1.00 | 0.00 | 2.85 |
| Education, BA or less | 0.32 | 0.47 | -1.674 | 0.19 | 0.01 | -23.13 |
| Education, MA or more | 0.13 | 0.34 | -0.521 | 0.59 | 0.07 | -4.35 |
| Asian | 0.05 | 0.22 | -0.152 | 0.86 | 0.12 | -1.10 |
| Black | 0.03 | 0.18 | -0.919 | 0.40 | 0.06 | -5.64 |
| Hispanic | 0.16 | 0.37 | -0.675 | 0.51 | 0.04 | -8.10 |
| Am. Indian | 0.01 | 0.07 | -0.165 | 0.85 | 0.37 | -0.38 |
| Race/ethnicity unknown | 0.00 | 0.06 | -0.171 | 0.84 | 0.34 | -0.43 |
| No. of obs. | | | | 1 | | |
| | | | 1,489 | | | |
| Chi2 | | | | 1 | | |
| | | | 546.26 | | | |
| Prob > chi2 | | | | 0 | | |
| | | | .00 | | | |

Table 5.4c

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1996 Will Be Credentialed:
Grade 4-6 Teachers**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.86 | 0.35 | 4.41 | | 0.99 | 4.46 |
| No. Pupils in school | 694.83 | 241.07 | 0.000 | 1.00 | 0.00 | 0.53 |
| No. pupils in school cubed | 4.69E+08 | 5.89E+08 | 0.000 | 1.00 | 0.00 | -2.25 |
| Pct. students Black | 8.36 | 11.56 | -0.022 | 0.98 | 0.01 | -3.55 |
| Pct. students Hispanic | 39.55 | 28.06 | -0.017 | 0.98 | 0.00 | -3.60 |
| Pct. students Asian | 9.25 | 11.26 | 0.010 | 1.01 | 0.01 | 1.16 |
| Pct. students Am Indian | 0.81 | 2.53 | -0.001 | 1.00 | 0.02 | -0.06 |
| Pct. students Free lunch eligible | 52.27 | 29.13 | -0.004 | 1.00 | 0.00 | -0.84 |
| Class size | 29.65 | 7.68 | 0.013 | 1.01 | 0.01 | 1.40 |
| Rural | 0.05 | 0.22 | 0.316 | 1.37 | 0.46 | 0.95 |
| Urban | 0.28 | 0.45 | 0.213 | 1.24 | 0.19 | 1.35 |
| Female | 0.75 | 0.43 | 0.351 | 1.42 | 0.18 | 2.78 |
| No prior experience | 0.55 | 0.50 | -0.338 | 0.71 | 0.14 | -1.69 |
| 1 - 3 yrs experience | 0.69 | 0.46 | -0.346 | 0.71 | 0.26 | -0.95 |
| Total experience | 4.33 | 6.29 | 0.043 | 1.04 | 0.07 | 0.65 |
| Total experience cubed | 1.26E+03 | 5.24E+03 | 0.000 | 1.00 | 0.00 | 0.85 |
| Age | 34.66 | 9.57 | -0.035 | 0.97 | 0.03 | -1.13 |
| Age cubed | 5.18E+04 | 4.57E+04 | 0.000 | 1.00 | 0.00 | 1.20 |
| Education, BA or less | 0.31 | 0.46 | -1.709 | 0.18 | 0.03 | -12.03 |
| Education, MA or more | 0.14 | 0.35 | -0.614 | 0.54 | 0.12 | -2.76 |
| Asian | 0.04 | 0.20 | -0.545 | 0.58 | 0.16 | -1.98 |
| Black | 0.05 | 0.21 | -0.624 | 0.54 | 0.15 | -2.24 |
| Hispanic | 0.13 | 0.34 | -0.657 | 0.52 | 0.08 | -4.32 |
| Am. Indian | 0.01 | 0.09 | 0.154 | 1.17 | 0.87 | 0.21 |
| Race/ethnicity unknown | 0.01 | 0.09 | 0.232 | 1.26 | 0.91 | 0.32 |
| No. of obs. | | | 3,176 | | | |
| Chi2 | | | 380.50 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.4d
Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1996 Will Be Credentialed:
Grade 6-8 Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.85 | 0.36 | 4.41 | | 0.76 | 5.79 |
| No. Pupils in school | 938.22 | 424.64 | 0.000 | 1.00 | 0.00 | -1.98 |
| No. pupils in school cubed | 1.51E+09 | 4.91E+09 | 0.000 | 1.00 | 0.00 | 2.29 |
| Pct. students Black | 8.66 | 11.31 | -0.026 | 0.97 | 0.01 | -4.60 |
| Pct. students Hispanic | 34.93 | 25.24 | -0.016 | 0.98 | 0.00 | -3.60 |
| Pct. students Asian | 11.49 | 13.08 | -0.004 | 1.00 | 0.01 | -0.59 |
| Pct. students Am Indian | 0.88 | 2.81 | -0.021 | 0.98 | 0.02 | -0.87 |
| Pct. students Free lunch eligible | 43.33 | 25.69 | -0.004 | 1.00 | 0.00 | -1.01 |
| Class size | 32.44 | 21.06 | -0.004 | 1.00 | 0.00 | -1.08 |
| Rural | 0.06 | 0.23 | -0.208 | 0.81 | 0.24 | -0.69 |
| Urban | 0.30 | 0.46 | 0.203 | 1.23 | 0.18 | 1.37 |
| Female | 0.60 | 0.49 | 0.259 | 1.30 | 0.14 | 2.39 |
| No prior experience | 0.47 | 0.50 | -0.641 | 0.53 | 0.09 | -3.62 |
| 1 - 3 yrs experience | 0.63 | 0.48 | -0.177 | 0.84 | 0.23 | -0.63 |
| Total experience | 5.12 | 6.98 | 0.110 | 1.12 | 0.04 | 2.78 |
| Total experience cubed | 1.69E+03 | 6.51E+03 | 0.000 | 1.00 | 0.00 | -0.80 |
| Age | 35.75 | 9.95 | -0.005 | 1.00 | 0.03 | -0.18 |
| Age cubed | 5.70E+04 | 4.91E+04 | 0.000 | 1.00 | 0.00 | 0.47 |
| Education, BA or less | 0.28 | 0.45 | -1.588 | 0.20 | 0.03 | -11.56 |
| Education, MA or more | 0.21 | 0.41 | -0.993 | 0.37 | 0.06 | -5.78 |
| Asian | 0.05 | 0.21 | -0.144 | 0.87 | 0.21 | -0.59 |
| Black | 0.06 | 0.23 | -0.818 | 0.44 | 0.11 | -3.32 |
| Hispanic | 0.11 | 0.31 | -0.545 | 0.58 | 0.09 | -3.43 |
| Am. Indian | 0.01 | 0.10 | -0.907 | 0.40 | 0.22 | -1.68 |
| Race/ethnicity unknown | 0.01 | 0.09 | 0.702 | 2.02 | 1.39 | 1.02 |
| No. of obs. | | | 3,317 | | | |
| Chi2 | | | 374.86 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.4e

**Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1996 Will Be Credentialed:
Grade 9-12 Math and Science**

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|---------------|---------------|---------|
| Dependent Variable/Constant | 0.81 | 0.40 | 2.76 | | 1.10 | 2.50 |
| No. Pupils in school | 1879.45 | 861.70 | 0.000 | 1.00 | 0.00 | -1.34 |
| No. pupils in school cubed | 1.11E+10 | 1.67E+10 | 0.000 | 1.00 | 0.00 | 1.07 |
| Pct. students Black | 8.05 | 9.80 | -0.021 | 0.98 | 0.01 | -2.22 |
| Pct. students Hispanic | 32.61 | 23.09 | -0.022 | 0.98 | 0.01 | -3.98 |
| Pct. students Asian | 12.92 | 13.85 | -0.003 | 1.00 | 0.01 | -0.37 |
| Pct. students Am Indian | 0.92 | 1.90 | -0.015 | 0.98 | 0.04 | -0.36 |
| Pct. students Free lunch eligible | 25.49 | 17.94 | 0.001 | 1.00 | 0.01 | 0.13 |
| Class size | 30.98 | 12.30 | 0.004 | 1.00 | 0.01 | 0.54 |
| Rural | 0.05 | 0.22 | -0.426 | 0.65 | 0.26 | -1.07 |
| Urban | 0.27 | 0.45 | 0.069 | 1.07 | 0.21 | 0.35 |
| Female | 0.42 | 0.49 | 0.227 | 1.25 | 0.18 | 1.56 |
| No prior experience | 0.46 | 0.50 | -0.432 | 0.65 | 0.15 | -1.84 |
| 1 – 3 yrs experience | 0.62 | 0.48 | 0.182 | 1.20 | 0.53 | 0.41 |
| Total experience | 5.30 | 7.04 | 0.164 | 1.18 | 0.11 | 1.69 |
| Total experience cubed | 1.70E+03 | 5.83E+03 | 0.000 | 1.00 | 0.00 | 0.22 |
| Age | 35.98 | 10.15 | 0.000 | 1.00 | 0.03 | -0.01 |
| Age cubed | 5.84E+04 | 5.09E+04 | 0.000 | 1.00 | 0.00 | 0.45 |
| Education, BA or less | 0.29 | 0.45 | -1.442 | 0.24 | 0.04 | -8.15 |
| Education, MA or more | 0.28 | 0.45 | -0.363 | 0.70 | 0.16 | -1.62 |
| Asian | 0.07 | 0.26 | -0.121 | 0.89 | 0.23 | -0.47 |
| Black | 0.04 | 0.20 | -0.562 | 0.57 | 0.21 | -1.55 |
| Hispanic | 0.09 | 0.29 | -0.154 | 0.86 | 0.19 | -0.70 |
| Am. Indian | 0.01 | 0.11 | 0.623 | 1.86 | 1.26 | 0.92 |
| Race/ethnicity unknown | 0.00 | 0.06 | -0.416 | 0.66 | 0.83 | -0.33 |
| No. of obs. | | | 1,669 | | | |
| Chi2 | | | 266.77 | | | |
| Prob > chi2 | | | 0.00 | | | |

Table 5.4f
Logistic Regression Results: Odds That A Newly Hired Teacher
Assigned to a School in 1996 Will Be Credentialed:
Grade 9-12 Other Teachers

| | Mean | Std. Dev | Coef | Odds Ratio | Std. Error | z-score |
|-----------------------------------|----------|----------|--------|------------|------------|---------|
| Dependent Variable/Constant | 0.86 | 0.35 | 3.362 | | 0.65 | 5.15 |
| No. Pupils in school | 1865.12 | 864.17 | 0.000 | 1.00 | 0.00 | -0.19 |
| No. pupils in school cubed | 1.10E+10 | 1.68E+10 | 0.000 | 1.00 | 0.00 | -2.13 |
| Pct. students Black | 7.51 | 9.53 | -0.018 | 0.98 | 0.01 | -2.77 |
| Pct. students Hispanic | 32.51 | 22.99 | -0.014 | 0.99 | 0.00 | -3.77 |
| Pct. students Asian | 12.23 | 13.18 | -0.004 | 1.00 | 0.01 | -0.61 |
| Pct. students Am Indian | 1.01 | 2.22 | -0.009 | 0.99 | 0.05 | -0.18 |
| Pct. students Free lunch eligible | 25.87 | 18.65 | 0.001 | 1.00 | 0.00 | 0.15 |
| Class size | 31.02 | 16.72 | -0.004 | 1.00 | 0.00 | -1.41 |
| Rural | 0.06 | 0.23 | -0.479 | 0.62 | 0.18 | -1.62 |
| Urban | 0.28 | 0.45 | -0.042 | 0.96 | 0.15 | -0.27 |
| Female | 0.53 | 0.50 | 0.192 | 1.21 | 0.12 | 1.88 |
| No prior experience | 0.47 | 0.50 | -0.548 | 0.58 | 0.09 | -3.35 |
| 1 - 3 yrs experience | 0.63 | 0.48 | -0.060 | 0.94 | 0.26 | -0.22 |
| Total experience | 5.66 | 7.76 | 0.065 | 1.07 | 0.04 | 1.62 |
| Total experience cubed | 2.18E+03 | 7.24E+03 | 0.000 | 1.00 | 0.00 | 0.41 |
| Age | 36.00 | 10.42 | 0.008 | 1.01 | 0.02 | 0.40 |
| Age cubed | 5.91E+04 | 5.29E+04 | 0.000 | 1.00 | 0.00 | 0.21 |
| Education, BA or less | 0.26 | 0.44 | -1.537 | 0.22 | 0.03 | -12.20 |
| Education, MA or more | 0.25 | 0.44 | -0.675 | 0.51 | 0.09 | -4.04 |
| Asian | 0.04 | 0.19 | 0.277 | 1.32 | 0.41 | 0.90 |
| Black | 0.04 | 0.20 | -0.430 | 0.65 | 0.16 | -1.73 |
| Hispanic | 0.13 | 0.34 | -0.628 | 0.53 | 0.07 | -4.63 |
| Am. Indian | 0.01 | 0.10 | 0.589 | 1.80 | 1.30 | 0.81 |
| Race/ethnicity unknown | 0.01 | 0.08 | -0.275 | 0.76 | 0.44 | -0.48 |
| No. of obs. | | | 3,649 | | | |
| Chi2 | | | 344.98 | | | |
| Prob > chi2 | | | 0.00 | | | |

The results clearly indicate that the probability that a newly hired teacher assigned to a school will be fully credentialed is closely related to the characteristics of the pupils in both the district in which the school is located and in the school itself. For all teachers combined, and for most of the grade level subgroups, in both years, the odds that a newly hired teacher assigned to a school will be credentialed vary inversely with the proportions of Black or Hispanic students at that school. The result partially reflects the pattern we observed above: Districts with relatively many minority students have more difficulty in

recruiting credentialed teachers than do districts serving relatively fewer minority students. However, the results for the effects of the school's student body suggests that within districts, the newly hired teachers assigned to those schools serving relatively few minority students are more likely to be credentialed than are the newly hired teachers assigned to schools serving relatively many minority students.

THE TOTAL SUPPLY OF TEACHERS TO SCHOOLS

We assume that the district determines the number of teaching positions it will assign to any particular school based its enrollments and district preferences regarding the appropriate distribution of teachers among different types of pupils. Specifically, we assume the district determines the district-wide desired pupil/teacher ratio as described above. Given the district-wide staff ratio and the number and characteristics of pupils at a school, the district determines the number of teaching positions it will allot to that school.

To explore the extent to which the number of teachers a district allots to any particular school is based its' students characteristics, we compute the difference between the district-wide teacher/pupil ratio and the teacher/pupil ratio at each school in the district. If the difference is negative, the school has a larger teacher/pupil ratio than the district average; that is, it has fewer teachers per pupil than do the other schools in the district, on average. We then regress this difference on school and district characteristics, the racial/ethnic distribution of the students at the school, and the fraction of the students at the school eligible for free lunch. We also include the characteristics of the county in which the district is located (population density, the unemployment rate, average wage in all industries, average wage in federal employment).

Preliminary analyses suggested that the effects of some of the independent variables was nonlinear. To control for nonlinearities, we included those independent variables both linearly and cubed.

Table 5.5 presents the results for the 1995 school year. Table 5.6 presents the corresponding results for the 1996 school year.

Table 5.5
Regression Results: The Relative Distribution of Teaching Positions
Among Schools, 1994

| | Mean | St.Dev. | Coef. | t-statistic |
|---------------------------------------|----------|----------|--------|-------------|
| Dependent Variable/Constant | 1.07E-07 | 2.28E-06 | 0.22 | 0.38 |
| School characteristics | | | | |
| Fraction students Black | 0.08 | 0.13 | 4.98 | 11.49 |
| Fraction students Hispanic | 0.35 | 0.27 | 2.94 | 7.77 |
| Fraction students Asian | 0.11 | 0.13 | 0.84 | 1.87 |
| Fraction students Amer. Indian | 0.01 | 0.03 | 3.38 | 1.79 |
| Fraction students free lunch eligible | 0.47 | 0.29 | -0.640 | -2.34 |
| Suburban | 0.53 | 0.50 | -0.02 | -0.21 |
| Rural | 0.10 | 0.30 | 0.04 | 0.23 |
| No. pupils | 769.11 | 524.53 | -0.00 | -1.57 |
| No. pupils cubed | 1.43E+09 | 5.16E+09 | 0.00 | 0.65 |
| District characteristics | | | | |
| Total budget/pupil | 4,319.79 | 632.59 | -0.01 | -0.15 |
| Beginning teachers' salary (\$000s) | 26.06 | 2.16 | -0.00 | -0.05 |
| Fraction students Black | 0.08 | 0.09 | -4.87 | -8.07 |
| Fraction students Hispanic | 0.35 | 0.24 | -2.82 | -6.41 |
| Fraction students Asian | 0.11 | 0.11 | -0.77 | -1.29 |
| Fraction students Amer. Indian | 0.01 | 0.03 | -3.10 | -1.47 |
| Fraction students free lunch eligible | 0.45 | 0.22 | 0.54 | (.45 |
| Suburban | 0.61 | 0.49 | 0.02 | 0.14 |
| Rural | 0.07 | 0.26 | -0.04 | -0.18 |
| Growth | 0.01 | 0.02 | -0.11 | -0.07 |
| No. pupils (000s) | 17.40 | 1.17 | 0.01 | 0.60 |
| No. pupils cubed | 2.25E+13 | 7.20E+13 | -0.00 | -0.23 |
| No. schools | 81.49 | 177.71 | -0.00 | -0.34 |
| No. schools cubed | 23,700 | 75,500 | 0.00 | 0.26 |
| County Characteristics | | | | |
| Ave. wage, all industries (\$000s) | 28.24 | 5.03 | -0.00 | -0.07 |
| Ave. wage, federal employees (\$000s) | 38.04 | 4.79 | -0.00 | -0.04 |
| Unemployment rate | 9.04 | 3.27 | -0.00 | -0.15 |
| Population density (000s) | 1.37 | 2.09 | -0.00 | -0.12 |
| No. of observations | | | 5,847 | |
| R Square | | | 0.03 | |
| F | | | 6.86 | |
| Significance of the regression | | | 0.000 | |

Table 5.6**Regression Results: The Distribution of Teaching Positions
Among Schools, 1995**

| | Mean | St.Dev. | Coef. | t-statistic |
|---------------------------------------|----------|----------|-------|-------------|
| Dependent Variable/Constant | 1.26E-07 | 2.14E+05 | 0.14 | 0.27 |
| School characteristics | | | | |
| Fraction students Black | 0.09 | 0.13 | 4.27 | 10.30 |
| Fraction students Hispanic | 0.35 | 0.27 | 2.11 | 6.02 |
| Fraction students Asian | 0.11 | 0.13 | 0.98 | 2.38) |
| Fraction students Amer. Indian | 0.01 | 0.03 | 3.78 | 2.11 |
| Fraction students free lunch eligible | 0.48 | 0.29 | 0.15 | 0.58 |
| Suburban | 0.57 | 0.49 | 0.06 | 0.61 |
| Rural | 0.07 | 0.26 | 0.18 | 0.87 |
| No. pupils | 775.22 | 531.45 | -0.00 | -2.74 |
| No. pupils cubed | 1.49E+09 | 5.60E+09 | 0.00 | 0.19 |
| District characteristics | | | | |
| Total budget/pupil | 4,465.30 | 631.50 | -0.00 | -0.02 |
| Beginning teachers' salary (\$000s) | 26.83 | 2.19 | -0.00 | -0.04 |
| Fraction students Black | 0.08 | 0.09 | -4.22 | -7.48 |
| Fraction students Hispanic | 0.36 | 0.24 | -2.00 | -4.91 |
| Fraction students Asian | 0.11 | 0.11 | -0.86 | -1.59 |
| Fraction students Amer. Indian | 0.01 | 0.03 | -3.76 | -1.79 |
| Fraction students free lunch eligible | 0.46 | 0.23 | -0.26 | -0.76 |
| Suburban | 0.61 | 0.49 | 0.03 | 0.33 |
| Rural | 0.06 | 0.24 | -0.17 | -0.74 |
| Growth | 0.01 | 0.02 | 0.16 | 0.11 |
| No. pupils (000s) | 18.27 | 1.77 | 0.02 | 1.36 |
| No. pupils cubed | 2.34E+13 | 7.61E+13 | -0.00 | -0.79) |
| No. schools | 79.98 | 175.21 | -0.01 | -0.85 |
| No. schools cubed | 2.29E+07 | 7.41E+07 | 0.00 | 0.73 |
| County Characteristics | | | | |
| Ave. wage, all industries (\$000s) | 28.85 | 5.52 | 0.00 | 0.20 |
| Ave. wage, federal employees (\$000s) | 39.14 | 5.54 | -0.00 | -0.16 |
| Unemployment rate | 8.44 | 3.61 | 0.00 | 0.17 |
| Population density (000s) | 1.38 | 2.14 | -0.00 | -0.35 |
| No. of observations | | | 5,871 | |
| R Square | | | 0.04 | |
| F | | | 6.86 | |
| Significance of the regression | | | 0.000 | |

The regression coefficients for the percent of the pupils in a school that are Black or Hispanic are positive and highly significant in both years. Schools serving disproportionate numbers of Black or Hispanic students have fewer teachers per pupil than do other schools in the same district in which the fractions of the student body are drawn from these populations are smaller.

CONCLUSIONS

The racial/ethnic distribution of a school's students have a significant effect on its' teacher force. We reported, in the previous Section, that the odds that a teacher will leave a school are significantly positively related to the percent Black in the school for all teachers combined and for the teachers in each of the five separate grade level groups in both of the transition years included in our data. The magnitude of the effect varies somewhat between years and grade levels.

Table 5.7 summarizes the results of the models of the likelihood that a teacher will transfer from one school to another within a district.

Table 5.7
Odds That Teachers Will Transfer

| | All | K-3 | 4-6 | 6-8 | 9-12 Math & Science | 9-12 Other |
|-----------------------------------|-----|-----|-----|-----|---------------------------|---------------|
| 1995 | | | | | | |
| Inst. Exp./pupil | -- | -- | - | - | -- | -- |
| Adm. Exp./pupil | ++ | ++ | + | + | - | ++ |
| Maximum teachers' salary | ++ | + | + | + | ++ | + |
| Origin school | | | | | | |
| Pct. students Black | ++ | ++ | ++ | + | ++ | ++ |
| Pct. students Hispanic | ++ | ++ | ++ | ++ | ++ | ++ |
| Pct. students Asian | - | + | - | - | - | - |
| Pct. students Am Indian | + | + | + | - | ++ | - |
| Pct. students Free lunch eligible | ++ | ++ | ++ | ++ | - | + |
| Destination school | | | | | | |
| Pct. students Black | -- | -- | - | - | -- | -- |
| Pct. students Hispanic | -- | -- | -- | -- | -- | -- |
| Pct. students Asian | + | - | + | + | + | + |
| Pct. students Am Indian | - | - | - | - | -- | - |
| Pct. students Free lunch eligible | -- | -- | -- | -- | + | + |
| 1996 | | | | | | |
| Inst. Exp./pupil | -- | -- | -- | - | - | - |
| Adm. Exp./pupil | - | + | - | -- | - | - |
| Average teacher's salary | ++ | + | ++ | - | ++ | + |
| Origin school | | | | | | |
| Pct. students Black | ++ | ++ | ++ | ++ | + | + |

| | All | K-3 | 4-6 | 6-8 | 9-12 Math & Science | 9-12 Other |
|-----------------------------------|-----|-----|-----|-----|---------------------------|---------------|
| Pct. students Hispanic | ++ | ++ | ++ | ++ | - | ++ |
| Pct. students Asian | - | - | - | - | - | + |
| Pct. students Am Indian | + | + | + | ++ | + | + |
| Pct. students Free lunch eligible | ++ | ++ | ++ | + | -- | - |
| Destination school | | | | | | |
| Pct. students Black | -- | -- | - | -- | - | - |
| Pct. students Hispanic | -- | -- | -- | -- | + | -- |
| Pct. students Asian | + | + | + | - | + | - |
| Pct. students Am Indian | - | - | + | - | - | - |
| Pct. students Free lunch eligible | -- | -- | -- | - | ++ | + |

The relationship between the proportion of a school's students who are Black or Hispanic and the likelihood that a teacher in that school will transfer to another school in the same district is equally clear. The odds that a teacher will transfer out of a school are significantly positively related to both the percent Black and the percent Hispanic in the school for all teachers combined and for the teachers in each of the five separate grade level groups in both of the transition years. The odds that a teacher will transfer into a school are significantly negatively related to both the percent Black and the percent Hispanic in the school. Here, too, the result holds for all teachers combined and for the teachers in each of the five separate grade level groups in both transition years. The magnitudes of these effects vary between years and among grade levels. But there is a consistent pattern: Teachers tend to transfer out of schools having relatively high minority pupil populations and into schools having relatively low populations of minority pupils.

We see the same general pattern with respect to the percent of the students in a school who are eligible for free lunch. Teachers tend to transfer out of schools with high proportions of students from poor families and into schools with relatively low proportions of poor students.

Teachers leave districts for a variety of reasons, creating vacancies. Some of the teachers who remain in a district then transfer from their original position to a vacant position in

another school, effectively redistributing those vacancies toward schools serving relatively high minority populations. Districts then distribute newly hired teachers among the vacant positions. Table 5.8 summarizes the results of our analysis of the effects of the policy and student characteristic variables on the distribution of credentialed newly hired teachers among the schools in a district. The data clearly indicate that within districts, the newly hired teachers assigned to those schools serving relatively few minority students are more likely to be credentialed than are the newly hired teachers assigned to schools serving relatively many minority students. For all teachers combined, and for most of the grade level subgroups, in both years, the odds that a newly hired teacher assigned to a school will be credentialed vary inversely with the proportions of Black or Hispanic students at that school.

Table 5.8
Odds That Newly Hired Teachers
Assigned to a School Will Have a Credential:

| | All | K-3 | 4-6 | 6-8 | 9-12 Math & Science | 9-12 Other |
|-----------------------------------|-----|-----|-----|-----|---------------------------|---------------|
| 1995 | | | | | | |
| Pct. students Black | -- | -- | -- | -- | -- | -- |
| Pct. students Hispanic | -- | -- | -- | -- | -- | -- |
| Pct. students Asian | - | - | - | - | - | - |
| Pct. students Am Indian | - | - | - | -- | - | + |
| Pct. students Free lunch eligible | - | - | + | - | - | - |
| 1996 | | | | | | |
| Pct. students Black | -- | -- | -- | -- | -- | -- |
| Pct. students Hispanic | -- | -- | -- | -- | -- | -- |
| Pct. students Asian | - | - | - | - | - | - |
| Pct. students Am Indian | - | + | + | - | - | - |
| Pct. students Free lunch eligible | - | + | - | - | + | + |

Finally, some of the positions left unfilled after credentialed teachers are allocated to schools are filled by underqualified teachers. When all is said and done, the total number of teachers, credentialed or underqualified, per pupil at schools serving relative large numbers of Black or Hispanic students tend to have fewer teachers per pupil than do schools serving few of these students. Table 5.9 summarizes the results.

Table 5.9
The Relative Distribution of Teaching Positions
Among Schools

| | 1994 | 1995 |
|-----------------------------------|------|------|
| School characteristics | | |
| Pct. students Black | ++ | ++ |
| Pct. students Hispanic | ++ | ++ |
| Pct. students Asian | + | ++ |
| Pct. students Am Indian | + | ++ |
| Pct. students Free lunch eligible | -- | ++ |
| District characteristics | | |
| Pct. students Black | -- | -- |
| Pct. students Hispanic | -- | -- |
| Pct. students Asian | - | - |
| Pct. students Am Indian | - | - |
| Pct. students Free lunch eligible | + | - |

6. SUMMARY AND CONCLUSIONS

California has established criteria for the skills and knowledge teachers are presumed to need to be effective. Moreover, the skills and knowledge relevant to effective teaching are generally assumed to be subject matter specific. A teacher whose credential is in, say, mathematics, may be relatively ineffective in teaching a foreign language, and conversely. A teaching credential does not guarantee that the person holding the credential will be an effective teacher. And there are likely some individuals who lack a credential but are, nonetheless, very effective teachers. However, absent evidence to the contrary, we assume that the quality of the education offered to the students in a school depends on the extent to which their classes are taught by teachers qualified to teach those classes.

Assuming that possession of a credential in subject matter taught in a class is a necessary condition for an effective education, the quality of the education offered various pupil populations will depend on the fraction of the teachers in their school who are credentialed and the fraction of them who actually teach a class in the area covered by their credential. From this perspective, the analyses described above suggest that the quality of the education offered Black and Hispanic students is relatively deficient in comparison to the quality of the education offered other students. Specifically, the processes that affect the distribution of teachers among and within school districts systematically result in higher fractions of underqualified teachers in the districts and schools serving disproportionate numbers of Black and Hispanic students.

The analyses presented above describe an interacting series of processes, which, together, determine the distribution of teachers among districts and schools. The workings of these processes are generally correlated with students' characteristics in ways that result in relative concentrations of underqualified teachers in those districts and schools serving disproportionate numbers of Black and Hispanic students. We do not suggest that the processes that affect the distribution of teachers are necessarily sensitive to students'

characteristics as such. It is possible that some factor correlated with students' characteristics influences the workings of the market for teachers. For example, it may be that schools serving disproportionate numbers of Black and Hispanic students tend to differ from those serving relatively many other students in ways teachers generally deem unattractive or that these schools are more often located in neighborhoods that teachers consider less attractive and therefore try to avoid. However, whatever might be the forces driving these processes, they result in higher fractions of underqualified teachers in schools serving disproportionate numbers of Black and Hispanic students.

Teachers leave their schools and districts for a variety of reasons. Many of these reasons have nothing to do with the characteristics of students or their schools or districts. Teachers retire, become ill, move to a distant location for family-related reasons, and so on in response to external forces and inducements having nothing to do with districts, schools, or students' characteristics. However, we have seen that teachers are relatively more likely to leave districts and schools serving disproportionate numbers of Black and Hispanic students. This pattern may reflect teachers' direct responses to these factors. For example, it may be that some teachers find working in districts and schools serving these students less attractive and leave for that reason. Or the effects of these characteristics may be indirect in the sense that these districts and schools are relatively less attractive to teachers who are, therefore, relatively more inclined to respond to an external force or inducement drawing them away from these districts and schools. Either way, the result is that districts and schools serving disproportionate numbers of Black and Hispanic students incur relatively higher numbers of vacancies and, therefore, have relatively more positions to fill.

This pattern is replicated at the school level within districts. The odds that a teacher will leave a school are significantly positively related to the percent Black in the school.

Some of the teachers who leave a school within a district transfer to other schools in the same district. The relationship between the proportion of a school's students who are

Black or Hispanic and the likelihood that a teacher in that school will transfer to another school in the same district is clear: The odds that a teacher will transfer out of a school are significantly positively related to both the percent Black and the percent Hispanic in the school. The odds that a teacher will transfer into a school are significantly negatively related to both the percent Black and the percent Hispanic in the school. Thus, teachers tend to transfer out of schools having relatively high minority pupil populations and into schools having relatively low populations of minority pupils. A disproportionate fraction of intradistrict transfers involve teachers moving from schools serving relative large numbers of Black and Hispanic students to schools serving relatively smaller numbers of these students. Thus, the vacancies within a district tend to gravitate toward those schools serving disproportionate numbers of Black and Hispanic students. In sum, schools serving relatively many minority students incur relatively many vacancies to start with. Then, the vacancies in those schools serving relatively few minority populations tend to "shift" from those schools to the schools whose pupil populations include higher fractions of Blacks and Hispanics.

We see the same general pattern with respect to the percent of the students in a school who are eligible for free lunch. Teachers tend to transfer out of schools with high proportions of students from poor families and into schools with relatively low proportions of poor students.

Whatever may be the distribution of vacancies within a district, districts serving relatively high minority populations have relatively less success in attracting credentialed teachers. The racial/ethnic distribution of the students in a district was significantly related to the district's ability to recruit credentialed teachers. Further, the racial/ethnic composition of a school's student body is correlated with the odds that newly hired, credentialed teachers will be assigned to it. Within districts, the newly hired teachers assigned to those schools serving relatively few minority students are more likely to be credentialed than are the newly hired teachers assigned to schools serving relatively many minority students. The

odds that a newly hired teacher assigned to a school will be credentialed vary inversely with the proportions of Black or Hispanic students at that school.

Finally, some of the positions left unfilled after credentialed teachers are allocated to schools are filled by underqualified teachers. When all is said and done, the total number of teachers, credentialed or underqualified, per pupil at schools serving relative large numbers of Black or Hispanic students tend to have fewer teachers per pupil than do schools serving few of these students.

To examine the magnitude of these effects at the school level, we pooled our data for five years, 1993 through 1997. In each year, we divided the schools in the sample into two groups according to whether they were distinctly elementary (containing some combination of grades K-6) or distinctly secondary (containing some combination of grades 7-12). Schools that do not fall into either category, K-12, for example, are excluded. For each group, we examined the relationship between percent of all teachers who had a credential and the characteristics of the school's pupils. For secondary schools, we also examined the relationship between the percent of all teachers whose primary assignment was in one or another of five core subject areas—English, a language, mathematics, science, or social science—who had a credential and the characteristics of the school's pupils. Table 6.1 presents the results. The regressions reported in Table 6.1 are based on a fixed effects model; the t-statistics have been adjusted to reflect the correlation over time among observations by school.

Table 6.1a**Regression Results: Percent of Elementary Teachers Who Hold a Credential**

| | Mean | Std. Dev. | Coef. | t-statistic |
|-------------------------|--------|-----------|-------|-------------|
| Dep. Variable/Constant | 0.94 | 0.10 | 1.05 | 450.12 |
| No. pupils | 618.33 | 255.25 | -0.00 | -7.71 |
| Pct Free lunch eligible | 0.52 | 0.30 | -0.01 | -3.79 |
| Pct Hispanic | 0.37 | 0.28 | -0.08 | -17.59 |
| Pct Black | 0.09 | 0.13 | -0.14 | -18.81 |
| Growth | 0.01 | 0.08 | -0.01 | -1.81 |
| Year 1994 | 0.20 | 0.40 | -0.00 | -6.1 |
| Year 1995 | 0.20 | 0.40 | -0.03 | -22.11 |
| Year 1996 | 0.20 | 0.40 | -0.06 | -37.49 |
| Year 1997 | 0.20 | 0.40 | -0.10 | -52.95 |
| No. of obs. | 21,335 | | | |
| Chi2 | 4,209 | | | |
| Prob > chi2 | 0.0000 | | | |

Table 6.1b**Regression Results: Percent of Secondary Teachers Who Hold a Credential**

| | Mean | Std. Dev. | All teachers | | Core teachers | |
|-------------------------|---------|-----------|--------------|-------------|---------------|-------------|
| | | | Coef. | t-statistic | Coef. | t-statistic |
| Dep. Variable/ Constant | 0.93 | 0.10 | 1.01 | 324.82 | | |
| Dep. Variable/ Constant | 0.85 | 0.29 | | | 0.86 | 58.29 |
| No. pupils | 1042.25 | 900.24 | -0.00 | -4.67 | 0.00 | 11.99 |
| Pct Free lunch eligible | 0.31 | 0.24 | -0.02 | -3.22 | 0.82 | 3.87 |
| Pct Hispanic | 0.34 | 0.25 | -0.03 | -5.57 | -0.16 | -5.84 |
| Pct Black | 0.08 | 0.13 | -0.11 | -8.72 | -0.08 | -1.73 |
| Growth | 0.02 | 0.11 | -0.02 | -1.77 | -0.03 | -1.25 |
| Year 1994 | 0.20 | 0.40 | -0.00 | -2.18 | -0.01 | -2.921 |
| Year 1995 | 0.20 | 0.40 | -0.02 | -10.18 | -0.03 | -6.58 |
| Year 1996 | 0.20 | 0.40 | -0.04 | -16.08 | -0.05 | -9.61 |
| Year 1997 | 0.20 | 0.40 | -0.06 | -21.84 | -0.08 | -13.74 |
| No. of obs. | | | 7,906 | | 7,906 | |
| Chi2 | | | 821 | | 336 | |
| Prob > chi2 | | | 0.0000 | | 0.0000 | |

The percent of all elementary school teachers who held a credential was significantly negatively related to the percent of students in the school who are poor, Black, or Hispanic. The variables denoting years indicate the secular trend in the fractions of elementary teachers who held a certificate. The base year is 1993. The coefficient on the variable indicating 1994 is significantly negative, but very near zero. The fraction of

elementary teachers holding a certificate was lower in 1994 than it had been in 1993, but only by a small amount. The coefficients on the variables indicating the years 1995 through 1997 are all significantly negative and increasing in magnitude, indicating a downward trend in the fraction of elementary school teachers who held a credential.

The results for both all secondary school teachers and secondary school teachers whose primary assignment was in one of the core subject areas are basically similar. The results for the variables denoting years exhibit the same pattern that we found for elementary teachers. The coefficient on the variable indicating 1994 is essentially zero in both models. The fractions of all secondary teachers and of secondary teachers in core subjects who were credentialed were approximately the same in 1994 as in 1993, the base year. After the introduction of class size reduction, both fractions dropped dramatically. The coefficients on the variables indicating years 1995 through 1997 are all significantly negative and increasing in absolute value over time. The fractions of all secondary teachers and of secondary teachers in the core subjects who hold credentials are declining over time.

The dynamics of the labor market for teachers result in relatively greater initial vacancy rates in districts and schools serving disproportionate numbers of Black and Hispanic students. Intradistrict transfers then tend to “shift” vacancies within districts from those schools serving relatively large numbers of other students to those schools serving relatively large numbers of Black and Hispanic students. Although these processes result in increased relative vacancy rates in districts and schools serving Black and Hispanic students, these districts and schools are relatively less successful in recruiting credentialed teachers. In combination, these processes result in relatively less well qualified teacher staffs in the districts and schools serving disproportionate numbers of Black and Hispanic students.

In sum, if a teacher's qualifications are a measure of the quality of the education he or she provides, the dynamics of the teacher labor market result in systematically lower quality class offerings in schools serving disproportionately many Black and Hispanic students.

APPENDIX: A CONCEPTUAL FRAMEWORK FOR EXAMINING THE LABOR MARKET FOR TEACHERS

This Appendix presents a general conceptual framework for understanding the mechanisms that influence the distributions of qualified and underqualified teachers among schools and school districts.²⁰ We begin with a generic discussion of a competitive labor market framework and then compare the particular characteristics of the teacher labor market to the generic model – where they coincide with and depart from the standard competitive framework. We then use the framework to identify the data required to more fully examine the labor market for teachers.

THE PRINCIPLES GOVERNING A COMPETITIVE LABOR MARKET

The interaction of labor supply and labor demand occurs within the confines of a market. A labor market is composed of all of the buyers and sellers of labor services. In the case of teachers, the buyers are generally school districts and the sellers are those individuals who are willing to teach. The price of the labor service is primarily the wage²¹, and, in a competitive labor market, this is generally determined by the interaction of the forces of supply and demand.

The quantity of a particular type of labor demanded within a labor market consists of the number of such workers that employers in that labor market are *willing* to employ at prevailing wages.²² If prevailing wages increase, then demand is expected to decrease. Thus, an inverse relationship exists between demand and the price of labor.

²⁰ The foundation for the framework laid out here is presented in detail in basic labor economics textbooks. Broad discussions of the teacher labor market may be found in Murnane, et al. (1991) and Barro (1995).

²¹ For the purpose of simplicity, we describe compensation in terms of wages in this section of the framework. A more sophisticated and realistic description of compensation, however, would include benefits and working conditions. It can be assumed throughout this initial discussion, with no loss of generality, that the term “wages” carries with it the implications of “total compensation.” We will later discuss the components of total compensation separately in our discussion of response mechanisms to shortage conditions in teacher labor markets.

²² The “number” of workers referred to is more precisely defined as the number of full-time equivalent (FTE) workers, rather than the number of individual workers. Two part-time workers working at 50 percent time each, for example, make up one FTE.

A number of factors enter into the determination of labor demand in addition to the prevailing wage rate. Generally, an employer will weigh all factors and choose the optimal number of workers to employ. In economic terms, employers are said to maximize their objectives (these may be related to profits or other types of rewards or satisfactions) subject to the constraints imposed upon them by the particular budgets and production processes available to them. This decision-making or “optimization” process may produce similar results for all employers or may produce dissimilar results for different employers based upon differences in their objectives, production capabilities, or constraints. Wages will be a large factor in this decision, but other factors also come into play.

The quantity of a particular type of labor supplied within a labor market consists of the number of individuals qualified and *willing* to provide this labor at prevailing wages.²³ The quantity of labor supplied generally increases as the wage increases. Therefore a positive relationship exists between supply and the wage.

Many factors enter into the determination of supply. As in the case of demand, the actors in question—now, individuals rather than employers—undergo an optimization process in which they maximize their objectives subject to their own capability and time constraints. The decision of individuals to provide a particular type of labor will depend upon their preferences and the trade-offs they face among the various alternatives open to them. In general, it is the overall attractiveness of a particular type of job relative to other jobs or activities available to qualified individuals that determines their willingness to supply that type of labor. Wages will be a large factor in this decision, but other factors, such as the difficulty of obtaining prerequisite training, age, marital and parental status, and other household income are generally also related to these choices.

A labor shortage will exist if the quantity of labor demanded exceeds the quantity of labor supplied *at the prevailing wage rate*. The competitive market model assumes that wages

²³ Again, FTE rather than the number of people would be the more precise measure of supply.

are free to fluctuate according to demand- or supply-related pressures. It is assumed that labor markets can reach equilibrium—i.e., the state in which the quantity demanded equals the quantity supplied—through movements in the wage.

Movements along the supply and demand curves are produced in response to changes in the prevailing wage. The actual slope and position of the curve depends on a number of outside factors. The entire demand curve, for example, could shift upward (to the right) if the demand for the end product were to increase dramatically. The entire supply curve, for example, could shift downward (to the left) if outside opportunities for those qualified to perform the type of labor in question were suddenly to improve dramatically. These types of exogenous shifts in the curves represent important changes in the labor market that can upset an equilibrium state. When such changes occur, the prevailing wage is temporarily no longer the one in which the quantity of labor demanded equals the quantity of labor supplied.

Disequilibrium states are short-lived in markets in which wages are allowed to fluctuate freely and market actors are sensitive to these fluctuations. But, the rigidities of teacher labor markets render wages inadequate as a mechanism for adjustment or measure of labor market tightness.

Heterogeneity of jobs and workers—i.e., the fact that not all workers and not all jobs in the same job category are exactly alike—creates significant implications for a market response to a labor shortage. Workers of a specific type may differ in a number of ways, but, for the purposes of a labor market analysis, the most important dimension along which a distinction might occur is that of skill. It is often the case that different individuals with the same basic qualifications possess different amounts of skill. If workers of different levels of ability present themselves for the same type of job, then, all else equal, the natural preference on the part of employers would be to fill their job openings with the most able new hires, under the assumption that workers possessing greater skill will be more productive. The manifestation of this preference depends, however, on the ability of employers to distinguish the more from the less capable candidates. If skill differences are observable, then a price differential will most likely

arise between the more and less skilled workers, and two or more distinct labor markets will, in essence, arise.

Workers who meet the same minimum requirements for entry but differ in skill level will be highly substitutable. This will affect the magnitude of the price differential between the different skill groups, in accordance with the second principle of wage responsiveness outlined previously. It is to be expected that as the price differential between the two types of labor increases, the tendency will be to substitute the less able for the more able wherever it is advantageous to do so. Economic theory predicts that, if the two ability levels are distinguishable and if their wages can fluctuate freely in response to market forces, the wage differential will eventually reflect the exact difference in the value of their different productivity levels.

In addition to the existence of heterogeneity among workers, there may also be heterogeneity among jobs. In this instance, differences in working conditions represent the dimension of greatest relevance to the functioning of the labor market. The existence of identifiable heterogeneity among jobs in a competitive labor market with smooth wage adjustment mechanisms implies that compensating wage differentials will appear in order to equalize the remuneration for the different types of jobs.

If both the jobs and workers in a given labor market are heterogeneous and compensating wage differentials are non-existent or inadequate to offset the loss in satisfaction incurred from working in a more difficult job, then sorting will occur, in which the most skilled workers are first in the queue for the best jobs. In the absence of a freely adjusting and fully compensatory wage, this natural sorting behavior provides powerful measure of shortage or surplus conditions. Sorting implies that shortages will arise first in the less desirable jobs. Similarly, surpluses will arise first in the more desirable jobs.

THE LABOR MARKET FOR TEACHERS

In a competitive labor market, wages adjust to maintain a market equilibrium. However, teacher labor markets do not respond actively to changes in wages. Institutional factors

related to unions and public employment introduces rigidities into the wage determination process. Unions and districts to include premiums for education and within-district experience generally fix teacher salary schedules, but salaries are generally not allowed to vary by subject matter or individual. Due to pressures within the teaching profession to equalize salaries across teaching sub fields, wages in particular sub fields may not be allowed to deviate freely from others, despite the fact that the labor market for certain sub fields may be distinctly different in character from the others. In addition, unions and other labor institutions are generally more resistant to downward pressures on the wage caused by an excess of supply over demand than to upward pressures caused by an excess of demand over supply.

The current wage policies in effect for teachers ignore the fact that heterogeneity among teachers' leads to different labor markets. The scope of the market for people qualified to teach particular subjects, such as math or science, for example, may be larger than that of others, such as those qualified to teach English or history. Since the supply of labor to a given profession is determined by the wages of relevant alternative forms of employment as well as the wages offered by the profession itself, chronic shortages or surpluses can occur in certain teaching fields.

In addition to the rigidities introduced by institutional features of teacher labor markets, the demand for teachers experiences some inherent insensitivity to wage fluctuations. The principles of wage-responsiveness assert that responsiveness will be high if the demand for the end product is highly sensitive to price. In the case of teachers, education, a publicly provided good, is the end product, and the purchasers are the government and its constituent citizenry—that fund its production. The provision of such goods is, in general, less sensitive to price, because the actual consumers are not purchasing the good directly. Therefore, the demand for teachers may, on this count, be somewhat less sensitive to the wage. In addition, the principles of wage responsiveness assert that wage sensitivity will be high when other factors of production can substitute easily for labor. In the case of teachers, there are few true substitutes. Distance learning through television and computers, though useful in many circumstances, cannot offer the type of

psychological support that teachers provide and will most likely never replace teachers on a large scale.

Further, teaching jobs that are nominally the same may, in fact, present widely different working conditions. A science teacher in a wealthy school, for example, might find his or her job to be quite a bit easier than that of a science teacher in a poor school. The safety of the environment, the behavior and level of preparedness of the students, the facilities available may cause a great deal of variation within teaching job categories. One might expect that the variation will occur in strong relationship to the level of school wealth or social advantage.

Heterogeneity of skill within groups of similarly classified teachers is also a feature of teacher labor markets. Although it is difficult to construct measures of teaching skill, there are components of skill variation that have observable correlates. Teachers with experience, for example, are likely to possess more skill than inexperienced ones. Teachers with more education in pedagogy may also have a skill advantage. Teachers who possess more subject-matter knowledge may be similarly advantaged.

LESSONS FOR FUTURE POLICY AND FUTURE RESEARCH

Given the aggregate nature of our data, we have been unable in this report to address important policy questions regarding shortages in the teacher labor market. More precise studies of the characteristics of teachers, entry and exit into the profession, the wages of teachers and the relevant alternatives to teaching, and course offering patterns and course-taking patterns are needed. Behavioral models explaining the preferences of districts, students, and other relevant entities need to be developed on the demand side. Similar models explaining the preferences of potential teachers need further development on the supply side.

These points lead to a key questions: How can data collection efforts be improved?

A prelude to answering this question is to consider the utility of knowing whether there is a shortage or surplus in a specific subfield of teaching at a particular point in time.

Suppose, for example, we had uncovered a shortage of K-3 teachers, what would be the policy implications? In principle, such a finding could induce the key stakeholders in the education system to act. State policymakers, for example, could act to further reduce certification requirements which prevent individuals from entering teaching, state or federal officials could develop new programs or funding streams to boost the enrollment in teacher education programs, and so on.

But even if the needed information were available, the leverage points may be weak. Decisions are made by individuals and by schools and school districts in a highly decentralized manner. Without strong incentives—for example, higher salaries for subfields with a shortage, the market is likely to respond slowly. Furthermore, intervening in the labor market is potentially problematic when the market clearly responds with a lag. There is a possibility that “corrective” action would overcompensate for a shortage such that the market would be characterized by alternating “boom” and “bust” cycles. Having said this, reliable ongoing information on the labor market for teachers could be extremely useful to monitor and explain trends and to avert potential movement towards shortage in a productive and preemptive manner.

Should new data be collected at the state or federal levels? National data collection such as the Schools and Staffing Surveys are large, expensive undertakings. SASS, for example, in order to get representative samples of teachers in every state, involves gathering survey information from more than 40,000 individuals. It is impractical to do this on an annual basis. From a sampling design perspective, one is unlikely to be able to generate sufficient samples to generalize about school teachers in California. This suggests that although improvements could certainly be made in the SASS, and the federal government might consider more regular kinds of “snapshot” studies to provide useful information, it is state administrative data that holds the most promise.

California already collect detailed information on individual teachers and assignments. These data can be improved by adding more detailed information on teachers’ education

and experience. California also collects data from schools and districts on an annual basis, and it would be relatively straightforward to add additional items on vacancies, turnover, hiring plans difficulties of filling slots, recruitment activities, and so on, by subfield. It would be feasible to obtain a series of annual measures of the state of the labor market from school districts.

Aside from the lack of this supplementary information, two major omissions characterize California's data collection efforts. The first consists of data on the movements of teachers. Within the educational system itself, it should be possible to identify teachers and schools and to track teachers' movements in and out of specific districts. This is only part of the information needed to complete the picture, however. It is also necessary to track the movements of teachers in and out of the educational system. If state educational data collection agencies would collaborate with state employment and unemployment insurance agencies, it would then be possible to build longitudinal records capable of sustaining the type of analysis necessary for the understanding of teacher labor market transitions. The importance of gathering this information as a means of assessing the possibility of shortages and surpluses cannot be overemphasized.

Second, data on teacher characteristics indicative of quality are virtually nonexistent. In order to assess whether districts are substituting teachers of lower quality for those of higher quality over time-an important indicator of a shortage-researchers must have a means of distinguishing different quality levels of teachers. This is a problem that is endemic to all educational research due to the difficulty of determining adequate quality measures. Despite this difficulty, however, California does not report even simple quality measures, such as scores on the CBEST test taken by all teachers. In particular, changes in the performance of students after exposure to particular teachers are rarely tracked, yet this information would provide extremely valuable data on teacher quality.

In revealing the building blocks of supply and demand, our study highlights the absence of data on key indicators and identifies the type of longitudinal data needed to assess shortage or surplus conditions. In addition, it points to the need for further work in the

development of multivariate behavioral models capable of explaining all the relevant trends. At the current state of the art, teacher attrition has been modeled in some detail, but models of entry into the teaching profession, student course-taking decisions, district course-offering decisions, district hiring decisions, and local and state funding allocations are in their infancy. None of these types of behavioral models has been applied to the subfields of teaching. Answering questions regarding supply and demand and developing appropriate behavioral models will require both new quantitative and qualitative research, improved data collection efforts, the further application of theoretical rigor to teacher labor market phenomena, and the further subjection of theory to empirical testing at the local and state market levels.

BIBLIOGRAPHY

- Barro, S.M. (1995). Models for Projecting Teacher Supply, Demand, and Quality: An Assessment of the State of the Art. *Phi Delta Kappan*, 129-209.
- Baugh, W.H. and Stone, J. A. (1982). Mobility and Wage Equilibrium in the Educator Labor Market. *Economics of Education Review*, Vol. 2, No. 3, 253-274.
- Beaudin, B.Q (1995). Former Teachers Who Return to Public Schools: District and Teacher Characteristics of Teachers Who Return to the Districts They Left. *Educational Evaluation and Policy Analysis*, Vol. 17, No. 4, 462-475.
- Betts, Julian R., Kim S. Rueben, and Anne Danenberg (2000). *Equal Resources, Equal Outcomes?*, (Public Policy Institute of California, San Francisco).
- Bohrnstedt, G. W., and B. M. Stecher (1999), *Class Size Reduction in California: Early evaluation findings, 1996-1998*, CSR Research Consortium, Year 1 Evaluation Report, (American Institutes for Research, Palo Alto).
- Brewer, D.J. (1996). Paths and Quit Decisions: Evidence from Teaching. *Journal of Labor Economics*, Vol. 14, No. 2, 313-399.
- California Commission on Teacher Credentialing (1999), *1996-97 Annual Waiver and Permit Report*, available at <http://134.186.81.70/waiverreport/9697waiverreport.html>.
- California Department of Education (2000), *Comprehensive Basic Education Data System*, available at <http://goldmine.cde.ca.gov/>.
- Carroll, Stephen J. (1974). *Analysis of the Educational Personnel System: VIII. The Market for Teachers*, R-1344-HEW, (RAND, Santa Monica).
- Carroll, Stephen J., and Kenneth F. Ryder (1974). *Analysis of the Educational Personnel System: V. The Supply of Elementary and Secondary Teachers*, R-1341-HEW, (RAND, Santa Monica).
- Carroll, Stephen J. (1973). *Analysis of the Educational Personnel System: V. The Demand for Educational Professionals*, R-1308-HEW, (RAND, Santa Monica).
- Chapman, D.W. and Green, M. S. (1986). Teacher Retention: A Further Examination. *Journal of Educational Research*, Vol. 79, No. 5, 273 – 279.
- Charters, W. W. Jr. (1970). Some Factors Affecting Teacher Survival in School Districts. *American Educational Research Journal*, Vol. 7, No. 1, 1-27.
- Donahue, P. L., et al. (1999). *The NAEP 1998 Reading Report Card for the Nation and the States*, NCES 1999-500, U.S. Department of Education. Office of Educational

Research and Improvement, National Center for Education Statistics, Washington, DC: 1999.

Grissmer, D.W and Kirby, S.N. (1992). *Patterns of Attrition Among Indiana Teachers, 1965-1987*, (RAND, Santa Monica).

Grizt, R.M. and Theobald, N. D. (1995). The Effects of School District Spending Priorities on Length of Stay in Teaching. *The Journal of Human Resources*, Vol. 31, No. 3, 477-512.

Hanushek, E.A. and Pace, R.R. (1993). Understanding Entry into the Teaching Profession.

Kirby, S.N. and Grissmer, D.W. (1993). *Teacher Attrition: Theory, Evidence, and Suggested Policy Options*. (RAND, Santa Monica).

Kirby, S.N., Grissmer, D.W. and Hudson, L. (1991). *New and Returning Teachers in Indiana: Sources of Supply*. (RAND, Santa Monica).

Kirby, S.N., Berends, M. and Naftel, S. (1999). Supply and Demand of Minority Teachers in Texas: Problems and Prospects. *Educational Evaluation and Policy Analysis*, Vol. 21, No. 1, 47-66.

Legislative Analyst's Office (2000), *The 200-01 Budget: Perspectives and Issues*, (Legislative Analyst's Office, Sacramento).

Manski, C.F. (1986). Academic Ability, Earnings, and the Decision to Become a Teacher: Evidence from the National Longitudinal Study of the High School Class of 1972. In *Public Sector Payrolls* (Edited by Wise, D.E.), 291-317.

Mont, D. and Rees, D.I. (1996). The Influence of Classroom Characteristics on High School Teacher Turnover. *Economic Inquiry*, Vol. 34, 152-167.

Murnane, R.J. and Olsen, R.J. (1989) The Effects of Salaries and Opportunity Costs on Duration in Teaching: Evidence From Michigan. *The Review of Economics and Statistics*, 347-352.

Murnane, R.J. and Schwinden, M. (1989). Race, Gender, and Opportunity: Supply and Demand for New Teachers in North Carolina, 1975-1985. *Educational Evaluation and Policy Analysis*, Vol. 11, No. 2, 93-108.

Murnane, R.J., Singer, J.D. and Willett, J.B. (1988). The Career Paths of Teachers: Implications for Teacher Supply and Methodological Lessons for Research. *Educational Researcher*, 22-30.

- Murnane, R.J., Singer, J.D. and Willett, J.B. (1989). The influences of salaries and "opportunity costs" on teachers' career choices: evidence from North Carolina. *Harvard Educational Review*, Vol. 59, No. 3, 325 – 345.
- Murnane, R.J., Singer, J.D., Willett, J.B., Kemple, J.J. and Olsen, R.J. (1991). *Who will teach? Policies that matter*. Cambridge, MA: Harvard University Press.
- Richards, C.E. (1986). Race and Demographic Trends: the Employment of Minority Teachers in California Public Schools. *Economics of Education Review*, Vol. 5, No. 1, 57-64.
- Rickman, B.D. and Parker, C.D. (1990). Alternative Wages and Teacher Mobility: A Human Capital Approach. *Economics of Education Review*, Vol. 9, No. 1, 73-79.
- Shen, J. (1997). Teacher Retention and Attrition in Public Schools: Evidence From SASS91. *The Journal of Educational Research*, Vol. 91, No. 2, 81-88.
- Shields, Patrick M., et al., (1999) *The Status of the Teaching Profession: Research Findings and Policy Recommendations*, (The Center for the Future of Teaching and Learning, Santa Cruz).
- Singer, J. (1993). Once Is Not Enough: Former Special Educators Who Return to Teaching. *Exceptional Children*, Vol. 60, No. 1, 58-72.
- Theobald, N.D. (1990). An Examination of the Influence of Personal, Professional, and School District Characteristics on Public School Teacher Retention. *Economics of Education Review*, Vol. 9, No. 3, 241-250.
- Zarkin, G.A. (1985). Occupational Choice: An Application to the Market for Public School Teachers. *The Quarterly Journal of Economics*, 409 - 445.